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The taxonomic status of *Lachnagrostis scabra*, *L. aequata* and other related grasses in Australia (Poaceae).

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Abstract

Early descriptions and treatments of *Lachnagrostis scabra* (Beauv.) Nees ex. Steud.and *L. aequata* (Nees) S.W.L. Jacobs are examined and compared to current determinations of herbaria collections. The results of this study show a confusing array of nomenclature and inconsistency in descriptions given of these taxa. Additional assessment of a range of morphological characters on more than 100 specimens find coastal *L. scabra* and *L. aequata* to be inseparable, but taxonomically distinct from collections previously determined as *L. scabra* from inland Tasmania. The name *L. scabra* takes precedence for the coastal entity while the inland material is published as a new taxon, *L. morrisii* A.J. Brown and shown to be distinct from *L. collicola* (D. Morris) S.W.L. Jacobs. Further related and new taxa, *L. scabra* subsp. *curviseta* A.J. Brown from Victoria and *L. nesomytica* A.J. Brown subsp. *nesomytica*, *L. nesomytica* subsp. *pseudofiliformis* A.J. Brown and *L. nesomytica* subsp. *paralia* A.J. Brown from Western Australia are also described.

Introduction

There has long been uncertainty about the taxonomic relationship between *Lachnagrostis scabra (syn. Agrostis rudis)* and *L. aequata (A. aequata*). Early treatments had very few specimens on which to form judgements but with many collections being made over the last 50 years or so, the opportunity to more rigorously assess this situation is now possible. The current paper reports on a re-examination of the earliest published descriptions and on some detailed morphological assessment of the bulk of extant collections. This paper is part of an ongoing series dealing with a reassessment of the genus for Australia. Note that unless indicated as n.v. all cited collections have been viewed by the author.

In her revision of Australian species of *Agrostis*, Vickery (1941) separated *A. aequata* Nees from *A. rudis* Roem. & Schult., based on the degree of scabridity of the sides of the glumes. She differentiated the former from the latter "in the smooth sides of the glumes, which are less distinctly acute, equal or subequal both in length and breadth, not exceeding 2 mm in length". However, she also "retained both species until further material and field studies enable a conclusion to be reached". In her paper, she only cites three collections of each taxon, including the types; all but one, originating from Tasmania. The exception was an *A. aequata* collection from Nelson in Victoria. All the collections dated from 1792 to 1894 and had coastal locations (where provided).

TAXONOMIC TREATMENT IN STATE FLORAS POST VICKERY (1941)

Black (1943) tentatively recorded *A. aequata* for South Australia on the basis of the Nelson collection. Jessop and Toelken (1986) added *A. rudis* to the South Australian

flora, based on a few specimens from the South-east region. They also noted that *A. aequata* had been collected twice from the extreme south of the South-east.

In Victoria, Willis (1970) recorded *A. rudis* from a number of localities in southern Victoria; Main Ck near Arthurs Seat, Lake Corangamite, Gorae West near Portland and the Lower Glenelg R. from Moleside Ck downstream to Nelson and noted that collections from Lake Corangamite and Nelson had been determined as *A. aequata* by Vickery. Vickery (1941) had not previously cited the Lake Corangamite collection, despite it being one of Mueller's from 1875. Willis considered *A. aequata* to be "a slight variant" of *A. rudis*; its differing characters being "features merely of degree". Walsh and Entwisle (1994) agreed with Willis, regarding *A. aequata* as "being easily accommodated within the range of variation exhibited by *A. rudis*".

Jacobs and Pickard (1981) recorded *A. aequata* for the Southern Tablelands of NSW, based on a single collection from 1949.

Curtis and Morris (1994) recognised both *A. rudis* and *A. aequata* for Tasmania but noted the former as a plant of inland areas ("damp areas on margins of forest from 200 to 1200 m altitude") and limited the latter to coastal habitats. They reported that *A. aequata* "has generally smaller spikelets, glumes usually smooth and panicles in which the majority of spikelets have unawned lemmas."

Jacobs (2001a) placed *A. rudis* and *A. aequata* in *Lachnagrostis* as *L. rudis* (Roem. & Schult.) Trin. and *L. aequata* (Nees) S.W.L. Jacobs, respectively. Jacobs (2002) later corrected *L. rudis* to *L. scabra* (Beauv.) Nees ex Steudel. Recently, Barker *et al.* (2005), in their census of vascular plants of South Australia, accepted *Lachnagrostis* as a valid genus and regarded *L. aequata* as a synonym of *L. scabra*.

EARLY DESCRIPTION AND NOMENCLATURE REVIEW

The type for *Agrostis scabra* R.Br. non Willd., presumably collected by Robert Brown, is without location, collection number or date, although a notation on the reverse side of the collection sheet states "Van Diemens Land – Adventure Bay". Adventure Bay is located on the east side of Bruny Island in SE Tasmania. Adventure Bay was also the location cited by Vickery (1941) for a collection "in swamps" of *A. rudis* by Nelson in February 1792 (n.v.). However, as David Nelson died of a inflammatory fever in Timor on 20.7.1789, after enduring 41 days at sea in a small open boat with Captain William Bligh and 17 other men, following the Mutiny on the *Bounty* (Orchard 1999), either the date or the collector or both must be incorrect. Prior to the mutiny, Nelson had made botanical collections during the *Bounty's* anchorage at Adventure Bay (Orchard 1999) from 20th August to 4th September 1788, but this late winter-early spring period is not conducive for the collection of mature *Lachnagrostis*. Bligh did return to Adventure Bay on the *Providence* from 9th – 24th February 1792 but with James Wiles and Christopher Smith as botantists (Orchard 1999). Further collections were made at that time, the bulk of which were eventually lodged at BM with duplicates at DPU, FI, G, HO and K and it seems more likely that the 'Nelson' collection derives from this material. Unfortunately, the Adventure Bay collection cannot be located and does not appear to have been viewed since Vickery did so in 1938. However, the handwriting on the type collection for *Agrostis parviflora* RBr. from Adventure Bay "in black vegetable soil" and also labelled as Nelson, February 1792 in fact has been recently identified as that of Wiles (pers.com. R. Vickery). Nelson's name has been added to the sheet later by an unknown hand, perhaps in the belief that he was still Bligh's botanist in 1792. It is assumed that the *A. rudis* from Adventure Bay was treated likewise.

Robert Brown's trip to Australia of 1802-05 began as botanist for Captain Matthew Flinders on the *Investigator*. During the circumnavigation of Australia, Brown did make plant collections on King Island in Bass Strait (Moore 2000) and in Port Phillip Bay (Willis 1966) but only very late in the season (from April 23rd to May 3rd 1802). There is no mention of any grass collections in his diary notes of this period (Vallance *et al.* 2001). After the *Investigator* was condemned as unseaworthy, Brown returned to Tasmania on the *Lady Nelson*, leaving his collecting trips in the vicinity of Port Jackson on 28th November 1803. Originally planning to sail to Port Phillip, the *Lady Nelson* reached the Kent Island group in Bass Strait on 11th December where plant (mainly algae) collections were made (Moore 2000, Vallance *et al.* 2001). January 1st to 18th was spent at Port Dalrymple and along the Tamar River to the South Esk Gorge, near to the present site of Launceston. It is in this period that Brown records *Agrostis* along with other grasses on Green Island (opposite Outer Cove – now York Cove) on 3rd January 1804 and "immediately above the western arm" (a little further south of Green Island) on 5th January. Nine days were spent in Port Phillip Bay, Victoria from 21st to 30th January, assisting in packing up the ill-fated, Lt Col David Collins led settlement at Sullivans Bay (present day Sorrento) but Brown kept no diary of this period (Vallance *et al.* 2001). He then sailed south to Risdon Cove and Sullivans Cove, near present day Hobart, Tasmania with the settlers from Port Phillip Bay. From 9th February to 9th August 1803, after which he finally left Tasmania, Brown spent his time in the SE, largely exploring the Derwent River, Huon River and Mt. Wellington region. He made one late autumn-winter sea voyage towards the SW, including anchorage at Adventure Bay on 12th June (Vallance 2001). This appears to be the only occasion when Brown visited this site.

In Brown (1810), the description of his *A. scabra* collection is annotated with "J.D.", the 'J' referring to "vicinity of Port Jackson (including Hunter's River, Coal River)" and the 'D' to "Van Diemens Land" respectively. Bentham (1878) only refers to Brown's collection as deriving from "Port Jackson", while Vickery (1941) indicates "without locality". Given the lack of any other collections from coastal NSW, the Port Jackson location is highly unlikely. The reference to Adventure Bay on the reverse side of the sheet also appears erroneous; given the maturity of the collection but the winter landing on Bruny Island. The notation may refer to the earlier 'Nelson' (actually Wiles) location instead or in fact, the specimen may be a duplicate taken from that collection. If Brown did collect his own specimen, the most likely location would be at Port Dalrymple during early January 1804 or possibly at Port Phillip Bay in late January 1804. Although an undated collection of *Agrostis aemula* (syn. *Lachnagrostis aemula*) was made at Port Dalrymple by Col Patterson during the following summer and passed on to Brown in early 1805 (Vickery 1941, Vallance *et al.* 2001), *L. scabra* was also collected from "Tamar" in March 1887 by Oakden. The island, shoreline and creek mouth habitat where Brown observed his *Agrostis* would be conducive to *L. scabra* growth whereas the forested hillsides around Port Dalrymple would be more likely habitat for *L. aemula*.

Brown's (1810) description of his *A. scabra*, though brief, included keeled glumes with scabrid sides and a glabrous lemma with a denticulate apex and a spikelet-contained, dorsal awn. Roemer and Schultes (1817) and Steudel (1855) adopted Brown's description without change. Meanwhile, Nees (1843), when describing *A. aequata*, based on an 1838 collection by Gunn (1005) from Van Diemen's Land, describes the lemma as papery, smooth and obtuse and the glumes as equal with scabrid keels. There is no mention of the presence or otherwise of an awn.

When the two taxa were illustrated by Fitch and described by Hooker (1859) for Tasmania, the representations of his "*A. scabra* Br." are clearly not the same as Brown's

collection but appear to be a species or variant of *Deyeuxia*. The illustration (Plate CLXb) is rather similar to Fitch's rendering of *A. contracta* F. Muell. ex Hook.f. (syn. *D. contracta* (F. Muell. ex Hook.f.) Vickery), except that the lemma has a short, near apex awn and the palea is shorter, while Hooker's text includes *D. frigida* Mueller mss. (syn. *D. frigida* F. Muell. ex Benth.) as a synonym of *A. scabra* and suggested that the taxon may have been a variant of *A. montana* R.Br. non Krock (syn. *D. monticola* (Roem. & Schult.) Vickery). Hooker describes the taxon's spikelets as being "rough, often purple, $^{1}/_{6}$ inch long". At over 4 mm, these spikelets are somewhat larger than the 2.5 mm glumes, described by Vickery (1941) for *A. rudis*. Hooker also describes the lower palea (i.e. lemma) of *A. scabra* as "very rough, hard, sharp, nerves indistinct, awnless, or with a short, hardly exserted awn inserted at about the middle of the back". Apart from the inconsistent insertion of the awn, Fitch's illustration of the floret depicts Hooker's description well.

Hooker describes the habitat of *A. scabra* as being subalpine; from the foot of Mount Wellington, Arthurs Lakes etc.; citing collections from Gunn (1461, 1462), Archer and Oldfield (without numbers). In her treatment of *Deyeuxia*, Vickery (1940) recognised that Fitch's illustration and Hooker's description of *A. scabra* R.Br. were incorrect and assigns them to *D. scaberula* Vickery, although Gunn's "Arthurs Lakes" sample and Oldfield's unnumbered collection suggests that Hooker also included *D. accedens* Vickery in his *A. scabra*. Vickery (1940) placed the Tasmanian specimens of *D. frigida* cited by Bentham (1878) (Oldfield; New Norfolk, Gunn) in *D. accedens*. Despite her conclusions about Fitch and Hooker's rendering of *A. scabra*, Vickery (1941), when revising *Agrostis* still assigned Hooker's description to *A. rudis*. This was undoubtedly an oversight on her behalf.

Hooker's (1859) description of *A. aequata* spikelets expands on Nees (1843) account by stating that the glumes are "ovate, acute, hardly longer than the flower, very scabrid, especially along the keel" and that the paleas are "rather coriaceous, with obscure nerves, awnless; lower (i.e. lemma) truncate; upper (i.e. palea in the modern sense) nearly as long, with two small teeth at the tip, and sometimes a small tuft of hairs at the base" ("basi extus pedicello gracili" i.e. rachilla extension). Fitch's illustration also shows the glumes and lemma apex with ciliate margins. The collection by Gunn (1005) is cited by Hooker (1859) and is likely an isotype (Gunn, No. 1005/1837, 18.1.1838, H2003/00180 K) as Hooker's Plate No. CLIXb and pencil sketches of Fitch's illustration appear on one of the two sheets on which the type is mounted. Also attached to this type is a comment by Vickery, made on 9.7.1938 that it "matches type of *Agrostis aequata* Nees at Cambridge".

Bentham (1878) cited a few collections of these grasses from Tasmania but created a very confused scenario by his treatment of them. Gunn's collection (1005) was transferred to *Deyeuxia* as *D. aequata* Benth. (syn. *A. aequata* Nees), while he placed Brown's *A. scabra* and a collection from Adventure Bay (probably the erroneous 'Nelson'), in *D. scabra* Benth. However, also included in *D. scabra* were *D. contracta* and *D. decipiens* (R.Br.) Vickery (syn. *A. decipiens* R.Br.). Vickery (1940) regarded Bentham's description of *D. scabra* as also including her *D. scaberula*.

Bentham (1878) also designated the North American species, *A. scabra* Willd., for specimens from Tasmania, Victoria and NSW (regarding *A. parviflora* R.Br. as part of the species) and therefore, as a consequence, his appears to be the first Australian treatment to recognise *A. scabra* R.Br. non Willd. (i.e. as *Deyeuxia scabra* Benth.) as a separate taxon. The North American entity has, in the past, been regarded as a synonym for *A. hiemalis* (Walt.) Britton, Sterns and Poggenb. but has most recently been regarded as a separate taxon (Soreng and Peterson 2003). Although Vickery (1941)

"with some hestitation" placed a range of Australian specimens, including at least some of Bentham's citations (excluding *A. parviflora*), in *A. hiemalis*, Jacobs (2001b) has subsequently replaced it with two new endemic species; *A. propinqua* S.W.L. Jacobs and *A. bettyae* S.W.L. Jacobs..

In Tasmania, Rodway (1903) followed Bentham's (1878) treatment for *Deyeuxia* and *Agrostis* but included Circular Head (probably in reference to Gunn's collection) and Trial Harbour (collection by Rodway, December 1894) as locations for *D. aequata*. His illustration of *D. scabra* Benth. is likely to be of *D. scaberula* while that for *A. scabra* Willd. appears to be of *A. parviflora*.

For his Victorian plant key, Mueller (1888) combined all *Deyeuxia* and *Agrostis* under *Agrostis*; listing *A. scabra* (probably as a synonym for *D. scabra* Benth.) and *A. rudis* (presumably for *A. scabra* R.Br. non Willd.). The latter would appear to have been made on the basis of the collection he made from Lake Corangamite in 1875. Tate (1890) recorded *A. scabra* Willd. for the Mount Gambier district of South Australia; probably on the basis of a collection of *A. scabra* R.Br. non Willd. he made in 1882 from Nelson, in Victoria, near the South Australian border (Tate Herbarium, 15.11.1882) and without taking account of Bentham's (1878) separation of the North American taxon from the Australian entity or the presence of paleas in the florets of his specimen. Black (1922) recognised but renamed Tate's collection, *Calamagrostis aequata* (Nees) J.M. Black for South Australia but Ewart (1930) seems to have overlooked these taxa altogether for Victoria. His *Calamagrostis rudis* Steud. is cited as "a mountain grass" and probably refers to a *Deyeuxia* species (possibly *D. contracta*) while his *A. scabra* refers to the North American taxon.

Materials and Methods

MORPHOLOGICAL DESCRIPTION

At least 95% (134 specimens) of all current collections, determined as *L. scabra* and *L. aequata* at HO, MEL, AD and NSW were examined and measurements taken of leaf width, pedicel length (shortest and longest), glumes (lower and upper), glume setae, lemma, lemma setae, awn, palea, anther and rachilla extension length (including hairs) and the height of awn (if present) attachment on the lemma baCk Ratings of the degree of scabridity of the keels (1-3) and sides (0-2) of the glumes and cilia of the glume margins (0-2) and lemma apex nerves (0-2) were made. Measurements of spikelet and floret characters were made on one 'typical' mature example for each specimen. Panicle exsertion from the leaf sheath was noted and, if observed, peduncle length, panicle height and width and the distance between the two lower-most branch whorls (whorl separation) were measured.

In addition to types for *L. scabra* and *L. aequata* lodged at BM and K respectively, the 134 examined specimens (including the occasional duplicate) were as follows; Tasmania: 29 specimens of *L. aequata* from 23 locations, 23 specimens of inland *L. scabra* from 20 locations, 8 specimens from 3 sheets of *L. collicola* from 3 locations; Bass Strait Islands: 14 specimens of *L. aequata* from 8 locations; Victoria: 26 specimens of *L. scabra* from 21 locations; South Australia: 12 specimens of *L. scabra* from 10 locations; Western Australia: 21 specimens of an indeterminate taxon from 14 locations on Rottnest and Garden Islands. Among the Tasmanian collections, one determined as *L. aequata* (Archer undated and without location) was actually akin to

inland *L. scabra* while the reverse was true of another collection (Buchanan 8.1.1987 Wallaby Bay, Port Davey).

In addition to the collections as outlined above, two specimens from NSW, determined as *L. scabra* (originally determined as *A. aequata*) were also examined. One collected from Eden was found to be *Deyeuxia parviseta* var. *boormanii*. The other NSW collection, from Cathcart in 1949, was a very mature specimen with few intact spikelets and consequently difficult to determine with certainty. It appeared to conform to *L. scabra* in most discernible characters and could not be likened to any other taxonomic candidate, despite it's somewhat disjunct location from the known distribution range of the species. Further fresh collections from the field are required before confirmation can be assured.

During examination of specimens determined as *L. scabra* at HO (hereafter referred to as 'inland *L. scabra*'), some similarities with the Tasmanian montane species, *L. collicola* (D. Morris) S.W.L. Jacobs were observed. Subsequently, morphological characters for *L. collicola*, were compared to inland *L. scabra* to test their relationship.

In the course of this study, a collection at MEL of five sheets by Walcott in 1881 from Rottnest Island, Western Australia of an indeterminate taxon of *Lachnagrostis* were examined. Labelled by Mueller as *Agrostis* sp. it has obvious affinities with the *L. scabra*/*L. aequata* material. Subsequently, more recent indeterminate PERTH material from Rottnest Island (one specimen) and Garden Island (three specimens) were examined, measured, and compared to the first. An additional seven collections were made by the author on Rottnest Island in December 2004 and, although very mature, were still intact enough to examine vegetative, inflorescence and spikelet characteristics. A further nine collections were made in November 2005, at a time when plants were still green and inflorescences were emerging and becoming divergent.

STATISTICAL TREATMENT

Except for *L. collicola*, which was treated as a separate entity, examined specimens were grouped according to geographical source; i) Tasmania Mainland - Inland, ii) Tasmania Mainland - Coastal, iii) Tasmania - Bass Strait Islands, iv) East Coast Victoria and New South Wales, v) West Coast Victoria and South Australia and vi) Western Australia. A range of statistical analyses were undertaken using Genstat 8.1 (Release PL16, Lawes Agricultural Trust, Rothamstead Experimental Station). A correlation matrix (CORRELATE) for the character measurements was produced. In addition, a Symmetric Matrix (SYMMETRICMATRIX) of associations for the characters was established by forming a Similarity Matrix (FSIMILARITY) (using euclidean variate type for continuous variables and cityblock variate type for discontinuous variables). This matrix was used in both a Principle Coordinates Analysis (PCO) and a Hierarchical Cluster Analysis (HCLUSTER) (using Furthest Neighbour criterion) to assess natural groupings of the specimens. All of the measured characters were used in the multivariate analysis except for inflorescence height, width and distance between lower branch whorls (excluded because of unmeasurable characters in many specimens due to non-exserted panicles). Analysis of Variance (ANOVA) (LSD at 5%) for each measured character, was also performed using i) geographical source and ii) 75% threshold cluster groups, as treatments. For awn and inflorescence measurements, ANOVA was restricted to specimens with awns or exserted panicles respectively.

Table 1: Means in morphological characters (all lengths in mm) and percent of specimens with exserted inflorescences, hairy lemmas and awned lemmas for various taxa (designated by both old and new specific names) and geographical groupings (values followed by the same letter are not significantly different at 95% confidence limits).

Character	**Tas. Mainland**	**Tas. Mainland**	**Tas. Mainland**	**Bass Islands**	**East Vic and NSW**	**West Vic and SA**	**West Aust Islands**
locale	**inland**	**inland**	**coastal**	**coastal**	**coastal**	**coastal**	**island**
old name	***collicola***	***scabra***	***aequata***	***aequata***	***scabra***	***scabra***	**indet.**
new name	***collicola***	***morrisii***	***scabra***	***scabra***	***scabra***	***scabra***	***nesomytica***
Leaf width	1.6 *ab*	2.4 *cd*	1.9 *bc*	1.5 *ab*	2.1 *bcd*	2.7 *d*	1.2 *a*
Inflor. exsertion[a]	*38*	*61*	*66*	*86*	*60*	*75*	*81*
Inflor. height[1]	77 *a*	109 *ab*	142 *ab*	135 *ab*	132 *ab*	174 *b*	109 *ab*
Inflor. width[1]	53 *a*	104 *ab*	89 *ab*	104 *ab*	105 *ab*	111 *b*	112 *b*
Whorl separation[1]	14 *a*	24 *ab*	38 *abc*	26 *ab*	39 *abc*	44 *bc*	64 *bc*
Shortest pedicel	13.3 *d*	11.3 *c*	2.1 *a*	1.6 *a*	1.9 *a*	1.9 *a*	5.9 *b*
Longest pedicel	28.5 *c*	27.4 *c*	7.1 *a*	7.6 *a*	7.3 *a*	6.2 *a*	17.6 *b*
Lower glume	3.81 *e*	2.56 *d*	2.22 *c*	1.49 *a*	1.90 *b*	1.95 *bc*	2.54 *d*
Glume setae	0.18 *c*	0.08 *b*	0.07 *b*	0.00 *a*	0.02 *a*	0.03 *ab*	0.01 *a*
Upper glume	3.76 *d*	2.54 *c*	2.20 *bc*	1.54 *a*	1.91 *b*	1.90 *b*	2.33 *c*
Keel scabrids[b]	2.0 *b*	2.0 *b*	2.6 *c*	2.5 *c*	1.9 *b*	2.0 *b*	1.3 *a*
Lateral scabrids[b]	1.8 *c*	0.7 *b*	1.1 *b*	1.4 *c*	1.5 *c*	1.3 *bc*	0.1 *a*
Glume margins[b]	0.6 *b*	0.1 *a*	1.9 *d*	2.0 *d*	1.9 *d*	1.9 *d*	1.0 *c*
Lemma length	3.11 *d*	2.11 *c*	1.69 *b*	1.30 *a*	1.68 *b*	1.61 *b*	1.62 *b*
Lemma setae	0.33 *c*	0.06 *ab*	0.09 *b*	0.01 *a*	0.03 *ab*	0.03 *ab*	0.01 *a*
Lemma nerve[b]	0.0 *a*	0.0 *a*	1.8 *c*	1.5 *bc*	1.6 *c*	1.1 *b*	0.0 *a*
Hairy lemmas[a]	*0*	*0*	*0*	*0*	*0*	*25*	*38*
Lemma hairs[b2]	-	-	-	-	-	0.1 *a*	1.0 *b*
Callus hairs	0.49 *c*	0.33 *b*	0.25 *ab*	0.11 *a*	0.30 *b*	0.33 *b*	0.22 *ab*
Awn presence[a]	*100*	*100*	*38*	*29*	*33*	*54*	*100*
Awn attach[3]	89.6 *d*	94.1 *d*	71.1 *ab*	75.6 *bc*	79.5 *bc*	76.5 *bc*	63.5 *a*
Awn length[3]	2.50 *b*	0.61 *a*	0.51 *a*	0.36 *a*	0.48 *a*	0.38 *a*	1.74 *b*
Palea length	2.51 *d*	1.83 *c*	1.61 *b*	1.26 *a*	1.55 *b*	1.52 *b*	1.49 *b*
Rachilla extens.	2.14 *d*	0.97 *bc*	0.79 *b*	0.46 *a*	1.01 *bc*	1.10 *c*	0.96 *bc*
Anther length	0.70 *d*	0.50 *bc*	0.53 *c*	0.41 *a*	0.41 *a*	0.45 *ab*	0.52 *bc*

[a] Percent of specimens with character, [b] discrete variable recorded as a rating, [1] Restricted to specimens with exserted inflorescences, [2] Restricted to specimens with hairs on lemmas, [3] Restricted to specimens with lemma awns

Results

MORPHOLOGICAL ASSESSMENT

The correlation matrix (not provided) showed high (r^2 = 0.85-98) positive relationships between spikelet (glumes) and floret (lemma and palea) lengths as would be expected. In relation to glume and lemma lengths, anther length was moderately correlated (0.62-0.70), rachilla extension length was less correlated (r^2 = 0.55-0.64) and awn length was poorly correlated (0.32-0.59). Over all taxa, awn attachment height was poorly correlated (r^2 = − 0.39) to awn length although, within the WA island populations, correlations were high and negative (r^2 = − 0.86). High negative correlations (r^2 = − 0.77-0.82) were also found between glume margin cilia and the length of the shortest and longest pedicels, and pedicel lengths were moderately and positively correlated (r^2 = 0.64-0.67) to glume length. In other words, spikelets with longer pedicels had less evident cilia and tended to be larger. Glume margin cilia was positively correlated (r^2 = 0.69) to lemma apex nerve cilia but glume (lower and upper) scabridity (keels and laterals) were poorly correlated (0.27-0.53) to these characters. Other correlations (e.g. involving leaf width, callus hair length, inflorescence size) were mostly low (r^2 < 0.50). Figures 1 and 2 show the results of PCO and hierarchical cluster analyses respectively.

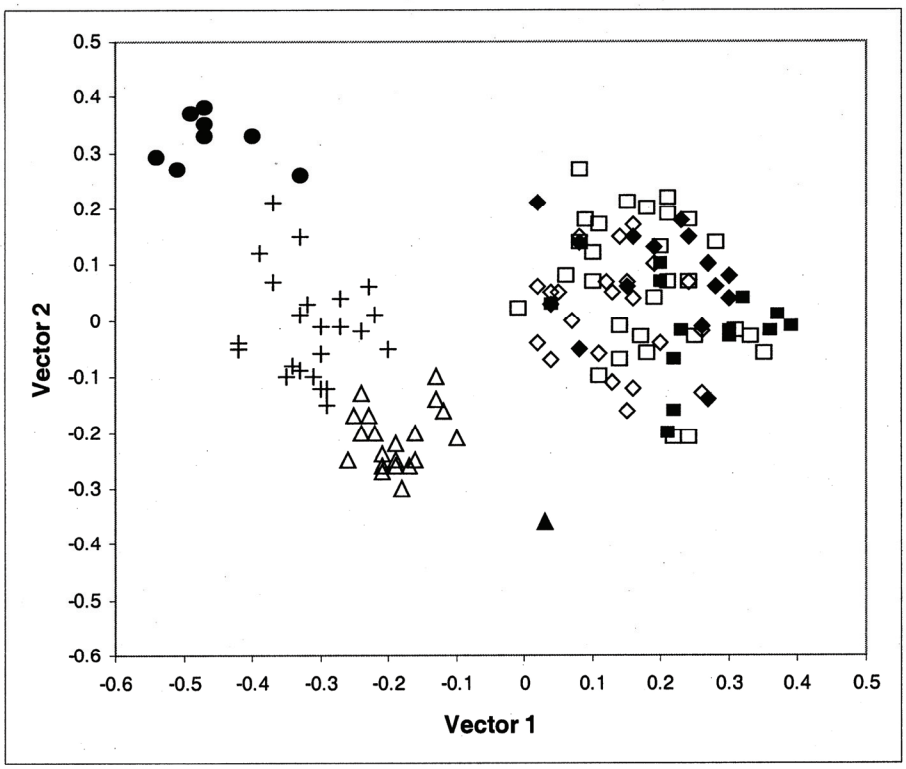

Figure 1. Vectors 1 and 2 of principle coordinate analysis of all examined specimens; L. collicola – Tasmania (●), inland L. scabra – Tasmania (+), L. sp. – Western Australian islands (Δ), L. aequata – Tasmania (□), L. aequata– Bass Islands (■), L. scabra – Western Victoria/South Australia (◊), L. scabra – Eastern Victoria (♦), indeterminate L. sp. – Cathcart, NSW (▲).

Lachnagrostis collicola, inland *L. scabra* and the WA islands plants are clearly separated in the PCO analysis from each other and strongly separated from a widely scattered and intermingled grouping containing coastal *L. scabra* and *L. aequata* (Figure 1). Vectors 1 and 2 of the PCO accounted for 51.3% of the total variation with vectors 3, 4 and 5 providing an extra 7.5%, 7.2% and 6.1% respectively. Table 1 shows the means in results for the characters measured for the various taxa and geographical groupings.

Lachnagrostis collicola is significantly different from the other taxa in having larger spikelets (lower and upper glume and glume setae length) and florets (lemma, lemma setae, awn, palea, callus hairs, rachilla extension and anther lengths). Ranges in both glumes, lemma, palea and rachilla extension length do not overlap with the ranges for these measurements on the other taxa. *Lachnagrostis collicola* is similar to inland *L. scabra* in always being awned and having a similar and high awn attachment, having

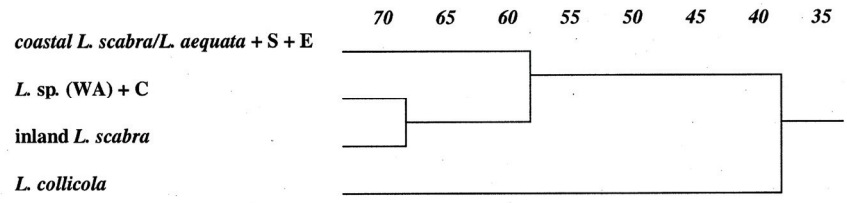

Figure 2. Dendrogram of hierarchical cluster analysis (furtherest-neighbour criteria) for all specimens (C = Cathcart specimen, S = Sherbrooke River specimen, E = Eight Mile Creek specimen); at 75% separation.

the same range in pedicel length and in lacking ciliate lemma nerves. However, in addition to its larger spikelets and florets, it differs from the latter, in almost always having narrower leaves and more scabrid sides to its glumes. The inland *L. scabra* from Tasmania is hereby recognised as a new taxon, separate to both *L. collicola* and coastal *L. scabra*/*L. aequata* and is described as *L. morrisii* A. J. Brown.

The material from Rottnest and Garden Islands is most similar to the montane *L. morrisii* but has, on average, smaller lemmas and paleas, longer awns that have lower lemma attachment, shorter callus hairs (often absent), less scabrid glumes but with more marginal cilia, shorter pedicels and narrower leaves with distinctly separate ranges for lemma length and awn attachment. From *L. scabra*/*L. aequata*, the specimens differ in having, on average, longer glumes (except for the Tasmanian group), awns and pedicels, but particularly in having less scabrid and/or ciliate glumes and lemma apices. These character differences, its habitat and its geographical isolation from the eastern Australian taxa have prompted the recognition of this entity as a new species; described as *L. nesomytica* A.J. Brown.

Although all the collections of *L. nesomytica* are superficially similar and were not clearly separated in the PCO (at least for the first two vectors) or hierarchial cluster analyses, some populations, as well as being geographically separated, are distinct enough to warrant recognition as separate subspecies. The populations on Rottnest Island are confined to the edges of saline lakes and swamps and obviously have high salt tolerance. Populations at Bickley Swamp, Serpentine and Government House Lakes (from the south-east part of the Island), differ from the remaining populations by having geniculate awns and moderately hairy lemmas. In these characters they resemble a stunted form of *L. filiformis* (Forst.) Trin. but have smaller spikelets and florets, longer anthers, shorter awns, longer pedicels and stiffer inflorescences with more divaricate branches. Typical *L. filiformis* has not been collected from the Island, although it occurs reasonably commonly on the adjacent mainland. The hairy lemma form of *L. nesomytica* is described here as subsp. *pseudofiliformis* A.J. Brown. The populations of *L. nesomytica* from the nearby Garden Island have been collected from coastal dunes in thickets of *Callistris preissii* and *Melaleuca lanceolata*; a highly calcareous but less saline environment (McArthur 1957) than that encountered by the other subspecies. Although having glabrous lemmas, as for typical *L. nesomytica*, they have longer, often curved to geniculate awns; though these are not as long as for subsp. *pseudofiliformis*. This entity is described as subsp. *paralia*.

The distributions of *L. aequata* from coastal Tasmania and the Bass Strait Islands and coastal *L. scabra* from the mainland are not separable and readily encompass the types for both taxa (Figure 1). They are therefore regarded as a single taxon; *L. scabra*

(Beauv.) Nees ex Steudel. Table 1 shows some significant differences in characters between geographical location for the taxon (e.g. the Bass Is collection has the smallest spikelets and florets and the Tasmanian collection has the largest anthers), but overall ranges (not provided) in these characters overlap. The degree of scabridity of the sides of the glumes, which was the main character used by Vickery (1941) to distinguish between *Agrostis rudis* and *A. aequata*, was found to be extremely variable and poorly correlated with any other measured character (the best correlation being only $r^2 = 0.32$ with the degree of glume margin ciliation). The presence of lemma awns is not linked to geographical location or correlated to spikelet/floret size. In some cases, both awned and unawned lemmas appear on the same specimen. Inequality in glume lengths bears little relationship to geographical location or to any other measured character.

Most specimens of *L. scabra* from the Furneaux Group of Bass Strait Islands, were small tussocks with divergent inflorescence branches and awnless or minutely awned lemmas. Apart from the general lack of awns, these plants have some resemblance to *L. nesomytica* subsp. *nesomytica*. However the latter have significantly longer pedicels and lack the cilia of lemma apices and the degree of glume scabridity. Although it is tempting to separate the Bass Strait Islands *L. scabra* from the mainland entity, there does not appear to be any clear difference in morphology, apart from tussock and inflorescence size. Plants of very similar tussock and inflorescence appearance but with hairy and long-awned lemmas are also found on these islands and are likely to represent a stunted form of *L. filiformis*. Another similar entity with hairy lemmas and very short, non-geniculate awns also occurs on Flinders Island, but its relationship to other Island forms is still under investigation by the author.

Examination of a previously indeterminate specimen at AD, collected by Eardley in 1942 from Eight Mile Creek, near Port MacDonnell, SA, was found to conform to *L. scabra* in all respects except that some of its lemmas had scattered short hairs near the margins of the lateral surfaces. Despite Eardley's comment that the grass 'comes in everywhere there', recent field searches for this population by the author has failed to find it. Closer examination of other specimens of *L. scabra* found at least five others with lemma hairs, all from South-east SA to South-west Victoria. However, these appeared to have only the occasional short hair on the occasional lemma and are therefore easily overlooked. Other specimens could well have the same condition. The sporadic and seemingly haphazard occurrence of this trait provides little support for creating a taxonomic distinction within *L. scabra*.

Another specimen, at MEL, labelled as *L.* aff. *scabra*, from Sherbrooke River, Port Campbell National Park (*Beauglehole and Finke 21182*, 6.ix.1966), also has an occasional hair on lemma margins but is distinguished from other *L. scabra* collections, in having longer (up to 1.4 mm) and often curved to somewhat flexuose or geniculate, very fine awns. This character appears distinctive enough to designate the specimen as a new taxon; *L. scabra* subsp. *curviseta*. The specimen from Wallaby Bay, Port Davey (*Buchanan 9339*, 8.i.1987), that had previously been determined at HO as inland *L. scabra*, has some awns from 0.9-1.1 mm long but these are straight and not curved.

Table 2: Means in morphological characters (all lengths in mm) for cluster grouping of *Lachnagrostis scabra* sensu strict. (i.e. coastal *L. scabra* and *L. aequata*) and percent of specimens within those groupings, according to geographical location.

Character	**Group 1** ***n = 44***	**Group 2** ***n = 6***	**Group 3** ***n = 25***	**Group 4** ***n = 7***
Leaf width	2.0 *b*	2.3 *b*	2.7 *b*	0.9 *a*
Inflorescence exsertion[a]	*70*	*94*	*57*	*62*
Inflorescence height[1]	148 *b*	152 *b*	175 *b*	50 *a*
Inflorescence width[1]	108 *b*	107 *b*	103 *b*	45 *a*
Whorl separation[1]	34 *b*	54 *c*	44 *bc*	15 *a*
Shortest pedicel	1.7 *a*	1.7 *a*	1.9 *a*	3.3 *b*
Longest pedicel	7.1 *a*	5.5 *a*	6.3 *a*	9.9 *b*
Lower glume	1.78 *a*	1.92 *a*	2.09 *a*	2.67 *b*
Glume setae	0.01 *a*	0.02 *a*	0.03 *a*	0.23 *b*
Upper glume	1.78 *a*	1.92 *a*	2.05 *a*	2.66 *b*
Glume keel scabrids[b]	2.3 *a*	2.2 *a*	2.3 *a*	2.4 *a*
Glume lateral scabrids[b]	1.4 *b*	0.5 *a*	1.3 *b*	1.1 *b*
Glume margins[b]	2.0 *b*	1.0 *a*	2.0 *b*	2.0 *b*
Lemma length	1.49 *a*	1.52 *ab*	1.72 *b*	1.96 *c*
Lemma setae	0.02 *a*	0.03 *a*	0.07 *ab*	0.13 *b*
Lemma nerve[b]	1.4 *a*	1.3 *a*	1.5 *ab*	2.0 *b*
Lemma hairs[b]	0.0 *a*	0.0 *a*	0.2 *a*	0.0 *a*
Callus hairs	0.18 *a*	0.27 *ab*	0.39 *b*	0.21 *a*
Awn presence[a]	*11*	*33*	*100*	*14*
Awn attachment[2]	71.8 *a*	75.2 *a*	75.9 *a*	70.0 *a*
Awn length[2]	0.23 *a*	0.55 *a*	0.50 *a*	0.40 *a*
Palea length	1.40 *a*	1.48 *a*	1.60 *a*	1.86 *b*
Rachilla extension	0.75 *a*	1.07 *b*	1.12 *b*	0.50 *a*
Anther length	0.43 *a*	0.48 *a*	0.48 *a*	0.59 *b*
Tasmania - Mainland (*n = 29*)[a]	*38*	*10*	*28*	*24*
Tasmania - Bass Islands (*n = 14*)[a]	*93*	*0*	*7*	*0*
East Victoria/NSW (*n = 15*)[a]	*60*	*7*	*33*	*0*
West Victoria/SA (*n = 24*)[a]	*46*	*8*	*46*	*0*

[a] Percent of specimens with character, [b] discrete variable recorded as a rating, [1] Restricted to specimens with exserted inflorescences, [2] Restricted to specimens with lemma awns

Because the overall collection of *L. scabra* (i.e. coastal *L. scabra* and *L. aequata*) showed a wide range in plant size, glume scabridity and other morphological features, more or less regardless of geographical location, further examination for possible taxonomic differentiation was made via hierarchical cluster analysis. When *L. scabra* was pooled without location differentiation and separately analysed from the other taxa, it formed two groups at the 60% threshold clustering and four groups at 70%. A dendrogram resulting from this analysis is shown in Figure 3. Floret (lemma and palea) size appears to be the major character separating the data at 60% clustering, but there is considerable overlap in the ranges for these measures. Members of Groups 1, 2 and 3 came from across the range of geographical locations, with the exception that almost all the Bass Strait Islands specimens fell into Group 1. Group 4 only had specimens from south-west, coastal Tasmania. Table 2 presents significant differences in means for morphological characters between these groups.

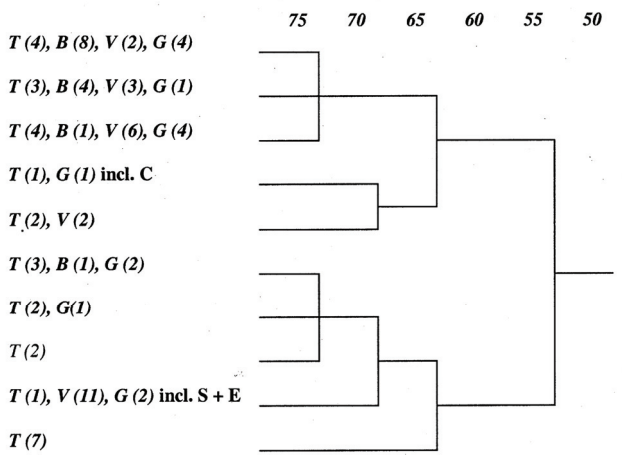

Figure 3. Dendrogram of hierarchical cluster analysis (further-neighbour criteria) for coastal *L. scabra*/*aequata* specimens (C = Cathcart specimen, S = Sherbrooke River specimen, E = Eight Mile Creek specimen) (numbers in parenthesis refer to number of specimens from geographical groupings in cluster at 80% separation; *T* = Tasmanian mainland, *B* = Bass Strait Islands, *V* = West Vic/SA, *G* = East Vic/NSW).

All but one of the specimens with lemma hairs were clustered together in Group 3 but in the original cluster analysis and in both PCO analyses they were dispersed throughout the data set. In terms of mean values, Group 4 significantly differed from the other groups in having the longest pedicels, spikelets (glumes, glume seta) and florets (lemmas, paleas and anthers) but the shortest rachilla extensions, the smallest inflorescences (height and width and whorl separation) and the narrowest leaves. However, in all these characters, their ranges overlap with the ranges of the other groups and cannot be used for diagnostic separation. Group 1 is only significantly different from Groups 2 and 3 in having shorter rachilla extensions. Group 2 is only significantly different from Groups 1 and 3 in having glumes with less scabrid laterals and ciliate margins. Again, ranges for these characters overlap between the groups. To give an example of range overlap; if all specimens with glumes 1.5 mm or less are considered (16 specimens; nine from Bass Islands, three from Tasmania and two each from East Vic/NSW and West Vic/SA), there are three awned with awn length ranging from 0.1-0.6 mm, shortest pedicels from 0.5-2 mm, longest pedicels from 4-13 mm, leaf width from < 1-2.5 mm and inflorescence height from 3-29 cm. At the other end of the scale; taking specimens with glumes 2.5 mm or greater (10 specimens; nine from Tasmania and one from Gippsland), there are six awned with awn length from 0.3-1.1 mm, shortest pedicels from 1-5 mm, longest pedicels from 4-21 mm, leaf width from < 1-4 mm and inflorescence height from 2-21 cm. In conclusion therefore, it does not appear feasible to segregate subspecific or varietal taxa from *L. scabra*, apart from subsp. *curviseta*.

The indeterminate specimen from Cathcart, NSW is separated from the main body of *L. scabra* in the PCO analysis (Figure 1). In the original (all specimens) hierarchical cluster analysis, the Cathcart sample appears with the Western Australian specimens (Figure 2) but then with Group 2 of the subsequent analysis of *L. scabra* only (Figure

3). Its advanced maturity meant that characters such as glume scabridity and lemma apex ciliation could not be adequately determined and its partially intact inflorescence does not provide a full description. It remains indeterminate until further collections in the locality can be made, if of course, it is extant.

Taxonomy

KEY TO TAXA TREATED IN THIS STUDY

The following key to the species of *Lachnagrostis* only deals with taxa of montane and coastal habitats and with small spikelets (4.0 mm or less). Other coastal or sometimes coastal taxa with larger spikelets are *L. billardierei*, *L. punicea* and *L. robusta* and descriptions of these can be found in Brown and Walsh (2000). Note that *L. scabra* has occasionally been found inland and *L. filiformis* is found from coastal to highland habitats. Mainly a lowland and ranges taxa, *L. aemula* sometimes occurs in montane habitats as well, but normally has larger spikelets than those dealt with here. It is the author's intention to provide a full key once the current revision of the genus is completed.

1. Shortest spikelet pedicels less than 4 mm long, lemma awned or unawned..... 2
1. Shortest spikelet pedicels 4 mm long or more, lemma always with an awn (sometimes minute) 6
2. Awns present, geniculate and at least twice the length of the lemma.....*L. filiformis*
2. Awns absent or if present, then less than twice the length of the lemma 3
3. Lemma covered in hairs 4
3. Lemma glabrous or with a few scattered hairs towards the margins 5
4. Plants mostly 10 cm in height or less, young leaf blades closely folded, anthers c 1.0 mm long..... *L. meionectes*
4. Plants mostly 20-40 cm in height, young leaf blades flat, anthers 0.6-0.8 mm long.....*L. lacunarum*
5. Awn absent or less than 1.0 mm long, more or less straight and not or hardly exceeding glumes .....1a. *L. scabra* subsp. *scabra*
5. Awn 1.0 mm long or more, mostly curved to geniculate and exceeding glumes by 0.5 mm.....1b. *L. scabra* subsp. *curviseta*
6. Awn arising from near the lemma apex or excurrent to the central nerve of the lemma 7
6. Awn not excurrent to the central nerve of the lemma but attached between ½ and ¾ of the lemma back 8
7. Glumes greater than 3.0 mm long (occasionally shorter if immature), awns generally greater than 1.5 mm long ..... 4. *L. collicola*
7. Glumes 3.0 mm long or less, awns less than 1.5 mm long .....2. *L. morrissi*
8. Awns mostly greater than 1.0 mm long, exceeding glumes, often curved to geniculate 9
8. Awns to 0.8 mm long, not exceeding glumes, straight.....3a. *L. nesomytica* subsp. *nesomytica*

9. Lemmas glabrous, awns generally 2.5 mm long or less.....3c. *L. nesomytica* subsp. *paralia*

9. Lemmas covered with scattered hairs, awns generally greater than 2.5 mm long..... 3b. *L. nesomytica* subsp. *pseudofiliformis*

TAXON DESCRIPTIONS

1. *Lachnagrostis scabra* (Beauv.) Nees ex. Steudel, *Nom. Botan.* Edn 2, 1:250 (1840); *Agrostis scabra* R.Br., *Prodr.* 172 (1810) non Willd. (1797); *Vilfa scabra* Beauv., *Agrost*. 16 (1812); *Agrostis rudis* Roem. & Schult., *Syst. Veg.* 2:360 (1817); *Lachnagrostis rudis* (Roem. & Schult.) Trinius*, Fund. Agrost.* 128 (1820); *Deyeuxia scabra* (Beauv.) Kunth, *Rev. Gram.* 1:77 (1829); *Calamagrostis rudis* (Roem. & Schult.) Steudel, *Syn. Pl. Gram*. 192 (1854). *Type:* Port Dalrymple, Tasmania (probable location), 1802-05, *R. Brown* (possible collector) (BM).

Agrostis aequata Nees, in *Hook. Lond. J. Bot.* 2:412 (1843), *Deyeuxia aequata* (Nees) Benth., *Fl. Austra.* 7:578 (1878); *Calamagrostis aequata* (Nees) J.M. Black, *Fl. South Australia*, Part 1:70 (1922); *Lachnagrostis aequata* (Nees) S.W.L. Jacobs, Telopea 9(3):445 (2001). *Type citation*: Tasmania, 18.1.1838, *Gunn 1005* (type: CGE n.v., probable isotype: K). [note: it is assumed on the basis of Vickery's comment on the isotype, that it is an adequate duplicate of the holotype].

Mid to light-green, loosely tufted or shortly rhizomatous, sometimes stoloniferous, glabrous, *annual or perennial*, of variable height from 10< cm (particularly in exposed coastal positions and on the Bass Strait Islands) to 200 cm (particularly in damp forests and on moist limestone rock faces); culms weakly ascending or scrambling to lax. *Leaf* blades rather lax, smooth, flat, to 15 cm long and from 0.2-4.0 mm wide; ligules obtuse, 1-3 mm long. *Inflorescence* generally a sparse, open panicle with spreading but rather lax and undulating branches (except in stunted plants), to 25 cm long or occasionally more, its base initially enclosed by the upper leaf sheath but often becoming exserted in mid-maturity; branches and pedicels green, or purplish where plants more exposed. *Spikelets* (1.3-)1.5-2.5(-3.0) mm long, pale to light green or sometimes purplish, on relatively short pedicels (shortest less than 4 mm long, longest almost always less than 15 mm long); glumes acute and keeled, subequal (sometimes the upper 0.1-0.2 mm longer), scabrous along the keel and often scaberulous or minutely papillose on the lateral surfaces (sometimes becoming densely scabrous towards the apex) but sometimes smooth, margins finely ciliate (at least in the upper half); lemma acute or obtuse, (1.1-)1.3-2.0(-2.2) mm long, minutely 4-toothed at the apex, generally with the upper nerves and teeth minutely and densely ciliate, body glabrous although very occasionally with a few scattered hairs near the margins on some florets in occasional populations, callus glabrous or with a few to some hairs 0.1-0.5 mm long; palea subequal to the lemma and often with a similarly ciliate and often rather obtuse apex; rachilla extension glabrous or plumose, (0.1-)0.4-1.5(-1.7) mm long (including hairs) or sometimes absent; anthers 0.3-0.6(-0.7) mm long. **Rough Blown-grass**

Notes: Also known as Even Blown-grass after '*aequata'* due to its subequal glumes, lemma and palea, or as Ruddy Bent, presumably after '*rudis'* though the latter means 'rough' or 'rude' and only purplish stunted specimens from exposed positions could be thought to approach 'reddish'.

1a. *Lachnagrostis scabra* subsp. *scabra*

Lemmas awnless or with a minute, fine and straight awn, 0.1-0.7(-1.1) mm long, arising from within the upper third of the lemma back and not or hardly exceeding the glumes (Fig 4a-h).

Distribution: Not common. Scattered along or within 15 km inland of the southern mainland coastline from Lake Tyers in Gippsland to Nelson in far-west Victoria and into south-east South Australia as far as Robe. Collections from further inland have been made in association with *Leptospermum lanigerum* near Lake Corangamite (*Mueller* 1875) and Poolaigelo at Salt Creek (*K. Alcock* 22.xii.1985) and Wannon Swamp (*K. Alcock* 1.i.1994) in Western Victoria. Also found on the Bass Strait Islands and scattered along the western and south-western coastline of Tasmania from Trial Harbour to South Cape Bay and Adventure Bay with some isolated occurrences on the north-western coast. An unverified determination on senesced material has also been made for Cathcart (*A.B. Costin 29*, viii.1949), New South Wales (Fig 5).

Ecology: Growing in damp ground, including seepage slopes, stream banks and swamps. Also found in cracks on limestone rock ledges and cliff faces and in sand and rocks above high tide on the fringe of coastal scrub. The species appears to be intolerant of hot, dry conditions and its absence from the east coast of Tasmania may reflect this, where annual rainfall is only half that of the west coast and maximum temperatures are higher.

Historical note: The location for Mueller's collection (March 1875 MEL2124488) was only given as "swamps at Lake Corangamite between *Leptospermum lanigerum*".

If it is assumed that Mueller was in fact referring to the vicinity of the Lake itself (which has a shoreline of at least 150 km) and not just a district within Victoria, the most probable site is about 10 km to the east of the Lake, at the Cummel or Camel Springs, Warrion (originally called Ti Tree). Later, but before the advent of automobiles, these freshwater springs were in the heart of a Common that supplied drinking water for cattle and horses on their way to market or which roamed free, grazing road reserves and crown land (*pers com*. E.W. Brown). If this were the collection site, it is unlikely that *L. scabra* survived the rigours of stock grazing and trampling, once this activity commenced in force. Certainly, recent searches in the area by the author have failed to find any remnant of the species or even the original Tea Tree. Surprisingly, *L. scabra* has never been collected anywhere else in the Volcanic Lakes district of Western Victoria.

Selected Specimens: **TASMANIA:** Tamar, iii.1887, *Oakden* (Formby 56) (MEL); Trial Harbour, xii.1894, *Rodway* (HO); Ettrick River, King Island, 7.iii.1966, *Willis* (MEL); Pot Boil Lagoon, Flinders Island, 15.i.1977, *Whinray 1522* (AD); Point Eric, Coxs Bight, 31.xii.1982, *Morris 82104* (HO); Pennerowne Point, 26.i.1984, *Moscal 5942* (HO, AD); 5 km south of Endeavour Bay, 30.i.1984, *Moscal 6014* (HO); Wallaby Bay, Port Davey, 8.i.1987, *Buchanan 9339* (HO); Welcome River, north of Redpa, 17.iv.1996, *Johnson* (HO). **SOUTH AUSTRALIA:** Rendelsham, 4.iii.1944, *Cleland* (AD); Dry Creek, Glenelg River, 29.xii.1963, *Beauglehole 5894* (AD, MEL); Little Mole Creek, 3.iv.1988, *Bates s.n.* (AD); Bluff Swamp, Tantanoola, 18.i.1993, *Bates 30964* (AD, CANB); Caroline Forest, 7.i.1994, *Bates 35759* (AD). **VICTORIA:** Gorae West, ii.1946, *Beauglehole* (MEL); tributary of Main Creek, Highfield National Park, 23.ii.1959, *Westaway* (MEL); above Tidal River, Wilsons Promontory, 13.i.1967, *Willis* (MEL); Stony Creek mouth, 8.8 km south-west of Apollo Bay, 7.i.1974, *Beauglehole 43955* (MEL); Lonely Arm, Lake Tyers, 11.xii.1976, *Cameron 7637* (MEL); Georges Rest, Lower Glenelg National Park, 15.ii.1991, *Albrecht 4724* (MEL).

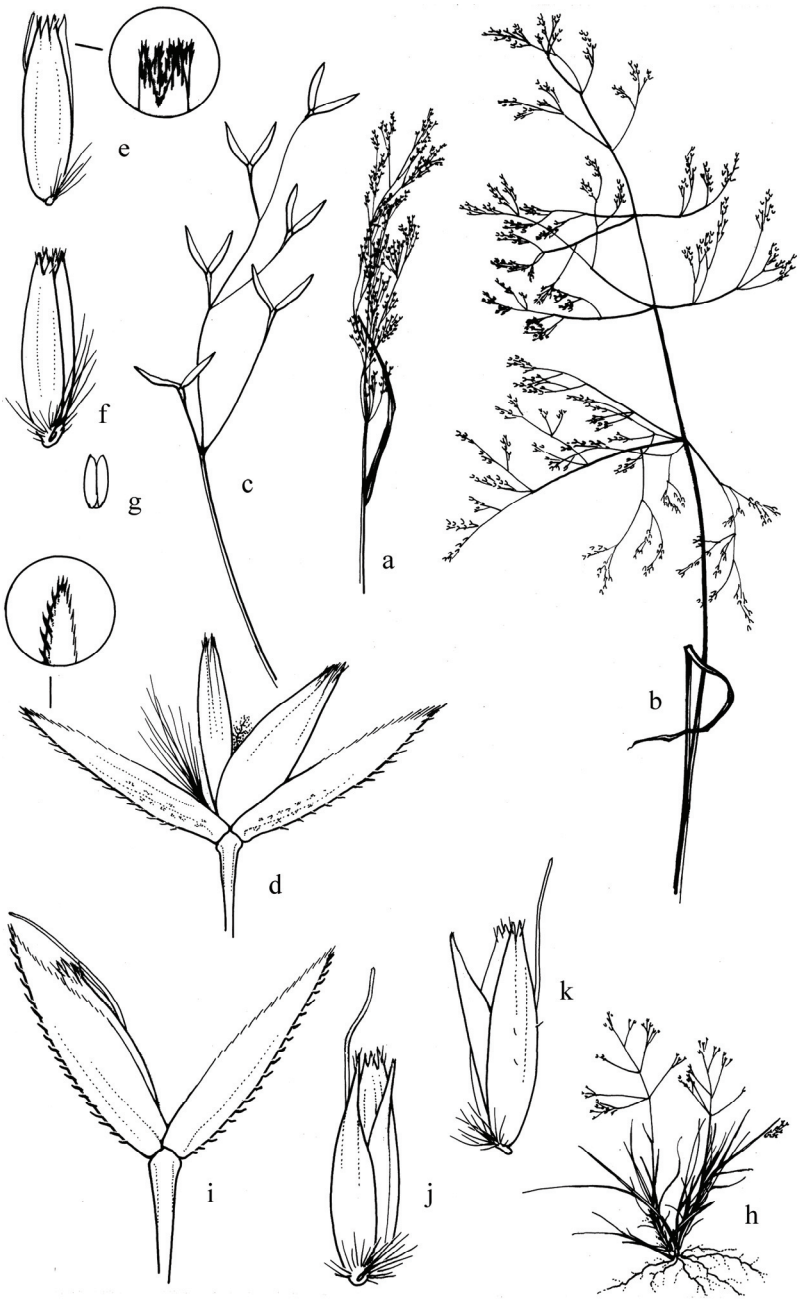

Figure 4: *Lachnagrostis scabra*: subsp. *scabra*: a immature contracted inflorescence x0.3; b mature expanded inflorescence x0.3; c glumes and pedicels x5; d spikelet x20; e awned floret x20; f unawned floret x20; g anther x20; h stunted plant from Bass Strait Islands x0.3; subsp. *curviseta*: i spikelet x20; j floret front view x20; k floret side view x20 (a-b Oakden, *Formby 56* MEL, c-g *Beauglehole 57801* MEL, h *Whinray 2223* MEL, i-k Type: *Beauglehole and Finke 21182* MEL).

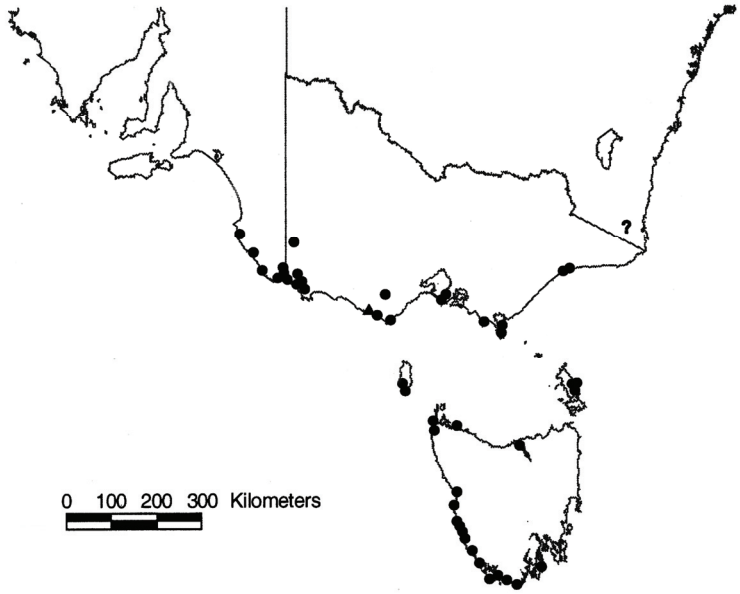

Figure 5: Distribution map of known collections of *Lachnagrostis scabra* in SE Australia (● subsp. *scabra*, ▲ subsp. *curviseta*, ? indeterminate *L.* sp. Cathcart).

1b. *Lachnagrostis scabra* subsp. *curviseta* A.J. Brown *subsp. nov.*

A subspecie typica arista lemmatis longiore (ad 1.4 mm longum) carvata vel geniculata differt.

Type: Sherbrooke River, Port Campbell National Park, Victoria, 6.ix.1966, *Beauglehole and Finke 21182* (holotype: MEL).

Glumes 1.7-2.3 mm long, often with a small terminal seta point (0.1-0.2 mm), scaberulous on the lateral surfaces and finely ciliate on the margins; lemmas 1.5-1.7 mm long, acute, occasionally unawned but mostly awned from the upper third of the lemma back with awns 1.0-1.4 mm long, curved to geniculate or sometimes straight, longer awns exceeding glumes by up to 0.7 mm (Fig. 4i-k).

Distribution: Known only from the Type.

Ecology: Not provided with collection but likely to be damp heath scrub vegetation.

Etymology: Named in reference to its curved awn.

2. *Lachnagrostis morrisii* A.J. Brown *sp. nov.*

A *L. scabra* (Beauv.) Nees ex Steud. pedicellis longioribus (saltem 4 mm), arista lemmatis semper excurrente ad nervum centralem sub 2 mm apice lemmatis inserta, lemmatibus et paleis nunquam ciliatis apicibus, glumis nunquam ciliatis marginibus differt.

Type: Russell Falls, Mt. Field National Park, Tasmania, 10.i.1948, *Curtis* (holotype: HO, isotypes: MEL, AD, AK n.v., RSA n.v.).

Agrostis rudis sensu., Curtis, W.M. and Morris, D.I., The Student's Flora of Tasmania, Part 4B, 1994. Agrostis rudis sensu., Kirkpatrick, J., Alpine Tasmania, An illustrated guide to the flora and vegetation, 1997.

Light green, loosely tufted, sometimes stoloniferous, glabrous, *annual or short-lived perennial*, to 50 cm height, culms weakly ascending to lax. *Leaf* blades rather lax, smooth to scaberulous on margins and nerves of lower surface, flat, to 15 cm long and from (1.0-)1.5-3.5(-4.5) mm wide, upper leaf sheaths scaberulous to finely papillose, ligules obtuse, soon erose, 2.5-3.0 mm long. *Inflorescence* a sparse, open panicle with spreading (lower branches reflexing with maturity), rather stiff and more or less straight branches, to 25 cm long, its base enclosed by the upper leaf sheath or exserted, branches and pedicels light green. *Spikelets* 2.0-3.0(-3.2) mm long, light green, on relatively long pedicels (shortest 5-15 mm long, longest 20-40 mm long); glumes acute and keeled, subequal (sometimes the lower 0.1-0.2 mm longer), scabrous along the keel and glabrous or sometimes scaberulous on the lateral surfaces, margins entire; lemma acute or obtuse, 1.7-2.6 mm long, minutely 4-toothed at the apex, upper nerves and teeth non-ciliate, body entirely glabrous or occasionally with a few hairs to 0.5 mm long on the callus; awn very fine and straight, 0.2-1.5 mm long, excurrent from the central nerve of the lemma (the lemma apex extending no more than 0.2 mm past the base of the awn); palea acute, 1.6-2.1 mm long, glabrous; rachilla extension plumose, (0.3-)0.5-1.5 mm long (including hairs); anthers 0.4-0.6 mm long (Fig. 6a-f). **Morris's Blown-grass.**

Notes: Lachnagrostis morrisii has some similarities to *L. collicola*, which also occurs within the Central Highlands of Tasmania (Morris 1990) but *L. morrisii* tends to have smaller spikelets, florets and awns, the glumes lack setae points and are less scabrid (particularly on the lateral surfaces). Panicles of *L. morrisii* are normally larger with more numerous spikelets and lack the purplish colouration of *L. collicola*.

Distribution: Endemic to the highlands of Tasmania, particularly the Central Highlands, mainly at altitudes of 600-1200 m but occasionally down to 200 m (Fig. 7).

Ecology: Growing in damp ground, including seepage slopes, cliff bases and stream banks; generally in shaded parts of forests; often on limestone or dolomite.

Etymology: The taxon is named in honour of the late Dr Dennis Morris of the Tasmanian Herbarium, a true gentleman and scholar, who tirelessly worked over many years, drawing attention to the unique flora of Tasmania.

Selected Specimens: **TASMANIA:** Tasmania, no date, *Archer* (HO); National Park, 19.i.1928, *Cleland* (AD); Longley, iii.1944, *Curtis* (HO); Tarraleah, near guesthouse, 7.ii.1945, *Curtis* (HO, AD); near Russell Falls, 16.i.1949, *Blake 18306* (HO); Lake St. Clair, 19.i.1949, *Blake 18335A* (HO); Hellyer River Gorge, 8.i.1967, *Willis s.n.* (MEL); Lake Little, 31.i.1982, *Buchanan 900* (HO); summit of Wherretts Lookout, 14.iii.1982, *Buchanan 950* (HO); Mt. Oakleigh, 26.i.1983, *Moscal 1490* (HO); Mt. Ronald Cross, 13.ii.1983, *Strappazon 1674* (HO); Rocky Hill, 15.ii.1983, *Moscal 1746* (HO); Croesus Cave State Reserve, 17.v.1983, *Moscal 2408* (HO); Devils Den, 18.iii.1984, *Moscal 7120* (HO); Florentine River, 16.iii.1985, *Moscal 10170* (HO); 3.5 km south of Jackeys Marsh, 11.ii.1986, *Moscal 12111* (HO); Weld River at Weld Arch, 17.i.1988, *Ziegeler* (HO); The Misty Voide, near Marakoopa Cave, 12.i.1991, *Collier 5107* (HO); Myrtle Forest Creek, 16.ii.1992, *Buchanan 12314* (HO); Lake Lea, 28.ii.1994, *Buchanan 13581* (HO).

Figure 6: *Lachnagrostis morrisii*: a immature contracted inflorescence x0.3; b mature expanded inflorescence x0.3; c glumes and pedicels x3; d spikelet x20; e floret x20; f anther x20 (a *Willis* MEL; b-f Type: *Curtis* isotype MEL)

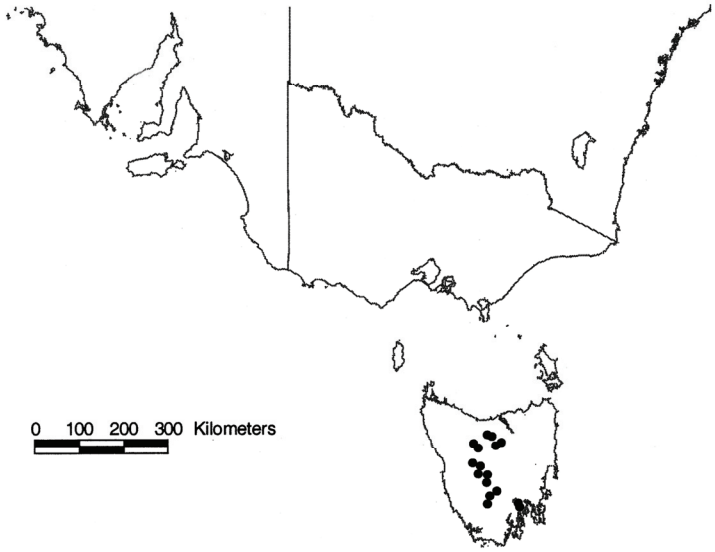

Figure 7: Distribution map of known collections of *Lachnagrostis morrisii* in SE Australia.

3. *Lachnagrostis nesomytica* A.J. Brown *sp. nov.*

A *L. scabra* (Beauv.) Nees ex Steud. pedicellis longioribus (saltem 4 mm), spiculis majoribus (saltem 2.2 mm), arista semper saltem 0.8 mm, lemmatis et paleis nunquam apicibus ciliatis differt.

Type: Lake Baghdad, Rottnest Island, Western Australia, 22.xi.1998, *Fox 005* (holotype: PERTH, isotype RTI).

Green or purplish, loosely tufted, glabrous, *annual or short-lived perennial*, 15-45 cm height, culms weakly ascending to lax. Leaf blades rather lax, smooth, flat to 10(-15) cm long and from 1.0-1.5 mm wide, ligules 4-5 mm long. *Inflorescence* a sparse, open panicle with spreading, rather stiff and more or less straight branches, to 20 cm long, its base sometimes enclosed by the upper leaf sheath but mostly exserted, branches, pedicels and glumes purplish-green to purple with age. *Spikelets* 2.0-2.8 mm long, on moderately long pedicels (shortest 4-7 mm long, longest 12-24 mm long), glumes acute and keeled, subequal or the lower slightly longer, scabrous along the keel and glabrous or very slightly scaberulous on the lateral surfaces, margins slightly ciliate; lemma acute, 1.5-1.8 mm long, minutely toothed at the apex, upper nerves and teeth non-ciliate, body glabrous or covered with scattered hairs, callus glabrous or with a few short (0.1-0.5 mm) hairs; palea acute, sometimes minutely bilobed, glabrous; rachilla extension plumose or sometimes glabrous, 0.6-1.4 mm long (including hairs); anthers 0.5-0.6 mm long. **Rottnest Island Blown-grass**

Notes: Despite the 1881 collection of this species, it appears to have been overlooked for almost 100 years. Plant species lists of the 1950's for Rottnest, Garden

and Carnac Islands failed to record any *Agrostis* (McArthur 1957). Extensive surveys of Rottnest Island from 1998-2001 listed only one collection of *Lachnagrostis*/*Agrostis*, that being the specimen nominated here as the type of *L. nesomytica*, then listed as *L. filiformis* (Rippey *et al*. 2003).

Etymology: After the Greek neso = island and mys = mouse or rat, in reference to the Dutch named Rottnest or Rats Nest Island.

3a. *Lachnagrostis nesomytica* subsp. *nesomytica*

Lemma glabrous with a fine and straight awn, 0.4-0.8 mm long, arising from about ¾ of the height of the lemma back; palea equal to or slightly shorter than the lemma (Fig. 8a-g).

Notes: Differs from *L. scabra* in its generally larger spikelets with longer pedicels and in its less scabrid glumes and lack of ciliate lemma apices. *Distribution*: Appears to be endemic to Rottnest Island; appearing to be restricted to the NW parts of the salt lake system (Fig. 9).

Ecology: Growing on the edges of saline lakes in peaty soil over limestone, in association with the samphire zone (e.g. *Halosarcia*, *Sarcocornia*) but in some places (e.g. Lake Baghdad) extending back into the *Gahnia trifida* community.

Other Specimens: **WESTERN AUSTRALIA:** Rottnest Island, 1881, *Walcott* (MEL); Lake Baghdad, Rottnest Island, 18.xii.2004, *Brown 1672*, *1673*, *1674* (MEL); Lake Negri, Rottnest Island, 18.xii.2004, *Brown 1675* (MEL); Lake Sirius, Rottnest Island, 18.xii.2004, *Brown 1676* (MEL); Lake Baghdad, Rottnest Island, 3.xi.2005, *Brown 1696*, *1697* (MEL).

3b. *Lachnagrostis nesomytica* subsp. *pseudofiliformis* A. J. Brown *subsp. nov.*

A subspecie typica lemma pilifero, arista geniculata saltem 3 mm longa differt.

Type: Serpentine Lake, Rottnest Island, Western Australia, 3.xii.2005, *Brown 1701* (holotype: PERTH, isotype: MEL).

Lemma covered with scattered short hairs and having a strongly geniculate awn, (2.4)3.0-3.8 mm long, arising from about ½ the height of the lemma back; palea equal to or slightly shorter than the lemma (Fig. 8j-l).

Notes: Spikelets are superficially similar to *L. filiformis* (Forst.) Trin. but the awns are finer and shorter. Paleas are subequal to lemmas, whereas those of *L. filiformis* are almost always distinctly shorter. The plants may resemble stunted forms of *L. filiformis* but the overall inflorescence appearance is stiffer and more widely divaricate, particularly when mature. The presence of this distinctive taxon so near the typical subspecies is worthy of further study at the genetic level.

Distribution: Appears to be endemic to Rottnest Island; largely occurring in the SE of the Island, though one collection has been made from Lake Baghdad (Fig. 9).

Ecology: Growing on the edges of saline swamps and lakes in samphire scrub and sometimes (e.g. Serpentine Lake) occurring at the base of the larger sedges (e.g. *Gahnia trifida*, *Ficinia nodosa*).

Figure 8: *Lachnagrostis nesomytica*: subsp. *nesomytica*: **a** spikelet x20; **b** floret back view x20; **c** floret front view x20; **d** floret half side view x20; **e** anther; subsp. *paralia*; **f** spikelet x20; **g** floret x20; subsp. *pseudofiliformis*: **h** immature contracted inflorescence x0.3; **i** mature expanded inflorescence x0.3; **j** spikelet x20; **k** floret back view x20; **l** floret side view x20 (**a-e** *Walcott* MEL, **f-g** *Rippey 383* MEL, **h**-l Type: *Brown 1701* isotype MEL).

Etymology: Subspecies named for its superficial likeness to *Lachnagrostis filiformis*.

Other Specimens: **WESTERN AUSTRALIA:** Bickley Swamp, Rottnest Island, 18.xii.2004, *Brown 1677* (MEL); Government House Lake, Rottnest Island, 18.xii.2004, *Brown 1678* (PERTH, MEL); Lake Baghdad, Rottnest Island, 3.xi.2005, *Brown 1698* (MEL); Serpentine Lake, Rottnest Island, 3.xi.2005, *Brown 1699*, *1700*, *1702* (MEL); Government House Lake, Rottnest Island, 3.xi.2005, *Brown 1703* (PERTH, CANB, MEL), *Brown 1704* (MEL).

3c. *Lachnagrostis nesomytica* subsp. *paralia* A.J. Brown *subsp. nov*.

A subspecie typica arista lemmatis semper 2 mm longa; a subspecie *pseudofiliformi* lemmate glabro et arista breviore differt.

Type: Garden Island, Western Australia, 20.x.1978, *R.J. Cranfield 43* (PERTH).

Lemma glabrous with a fine and gently curved to geniculate awn, 2.0-2.5 mm long, arising from about $^{2}/_{3}$ of the height of the lemma back; palea equal to or slightly (by 0.1-0.2 mm) longer than the lemma (Fig. 8h-i).

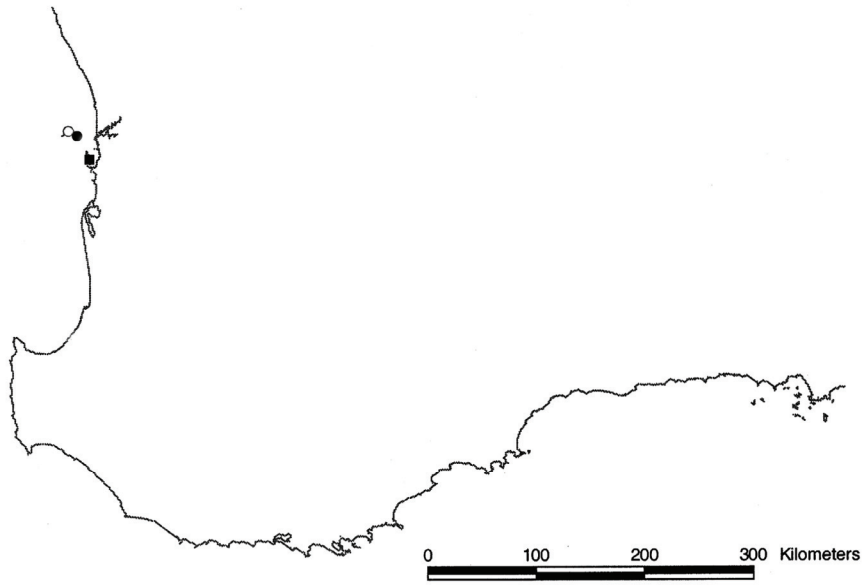

Figure 9: Distribution map of known collections of *Lachnagrostis nesomytica* in Western Australia (○ subsp. *nesomytica*, ● subsp. *pseudofiliformis*, ■ subsp. *paralia*).

Notes: Superficially similar to a delicate form of *L. filiformis* but the awns are finer (particularly in the lower part), remain pale rather than turning golden brown and tend to be attached a little higher on the lemma backs. The lemma backs are completely glabrous, unlike semi-glabrous forms of *L. filiformis* that at least have scattered hairs near the margins. Paleas are subequal to lemmas, whereas those of *L. filiformis* are almost always distinctly shorter. There are no records for *L. filiformis* on Garden Island, despite its close proximity to the mainland. The author has not had opportunity to survey the Island for *Lachnagrostis*. Because it is a Naval Support Facility, access is restricted to parts of the Island and limited to boat accessibility under curfew conditions.

Distribution: Appears to be endemic to Garden Island (Fig. 9).

Ecology: Growing on coastal dunes and swales in dry, calcareous, sandy soils in association with scattered *Callistris preissii* and *Melaleuca lanceolata*.

Etymology: The subspecific name derives from the Greek for 'Sea-side'.

Other Specimens: **WESTERN AUSTRALIA:** near Sewage Pond Road, Garden Island, 23.xi.2002, *Rippey 383* (PERTH, MEL, GDI); Buchanan Bay, Garden Island, 11.ix.2003, *Rippey 623* (PERTH, MEL, GDI).

4. Lachnagrostis collicola (D. Morris) S.W.L. Jacobs, Telopea 9:3 (2001).

Type: Tasmania, Saddle between The Hippo and Moonlight Ridge Hill 3, 10 Feb 1985, *Collier 309* (holotype: HO).

For a description of this grass, see Brown and Walsh, 2000: as *Agrostis collicola* (D. Morris) A.J. Brown and N.G. Walsh. Note that less developed spikelets on the same panicle can be smaller (down to 2.5 mm glume length) than in the mature spikelets reported in that paper.

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