



## *Rytidosperma robertsoniae* (Poaceae), a new species from southern Australia

Fleur Tiver

c/o State Herbarium of South Australia, GPO Box 1047, Adelaide, South Australia 5001

Email: fleur.tiver@gmail.com

**Abstract:** It has been known for some years that there is a  $2n=24$  chromosome race of *Rytidosperma caespitosum* from South Australia. It is unable to hybridize with other forms of the species tested so far and is reliably recognizable by a number of distinct morphological characters. It is here described as a new species, *R. robertsoniae* Tiver, and illustrated. Amendments to *Rytidosperma* keys in the *Flora of Australia* and *Grasses of South Australia* are provided. The type form of *R. caespitosum* from the Shark Bay area, Western Australia, is discussed, described and illustrated; a lectotype is chosen.

**Keywords:** biodiversity, new species, taxonomy, cytology, Australia, *Rytidosperma*

### Introduction

*Rytidosperma caespitosum* (Gaudich.) Connor & Edgar has long been recognised as “highly variable” (Vickery 1956). Vickery, whilst working on her revision of the then genus *Danthonia* in Australia, was aware that the species exhibited “a wide range of forms”, but was frustrated in her attempts to segregate infra-specific taxa, for although certain groups of specimens showed combinations of characters that might justify recognition, other specimens showed recombinations of the characters that “cut across” any projected scheme of classification.

At about the same time as Vickery was working on her revision of the genus, Abele (1959), a cytologist at the Waite Agricultural Research Institute in Adelaide, determined the chromosome number of Australian species of *Danthonia*. Enid Robertson, then curator of the Waite Herbarium, was managing and identifying the *Danthonia* collections for Abele’s (1959) project. Abele found three chromosome races within *D. caespitosa*,  $2n=24$ , 48 and 72 (Abele 1959). The majority of material examined was  $2n=48$ ;  $2n=72$  was found in a single population in the Adelaide Hills and a single specimen on southern Eyre Peninsula;  $2n=24$  was confined to six collections from “drier areas” of South Australia and New South Wales (Table 1). When the Waite Herbarium was closed, Robertson’s specimens, notes, unpublished manuscripts and drawings were transferred to the State Herbarium of South Australia (AD). The material had not been disturbed since its transfer to AD, but the specimens had never been assigned herbarium numbers. Of Abele’s six  $n=24$  specimens only five were able to be located at AD and one of these, the specimen from Trangie (N.S.W.), I

determined to be *R. setaceum* (R. Br.) Connor & Edgar (Table 1, Fig. 1), leaving only four specimens to be examined.

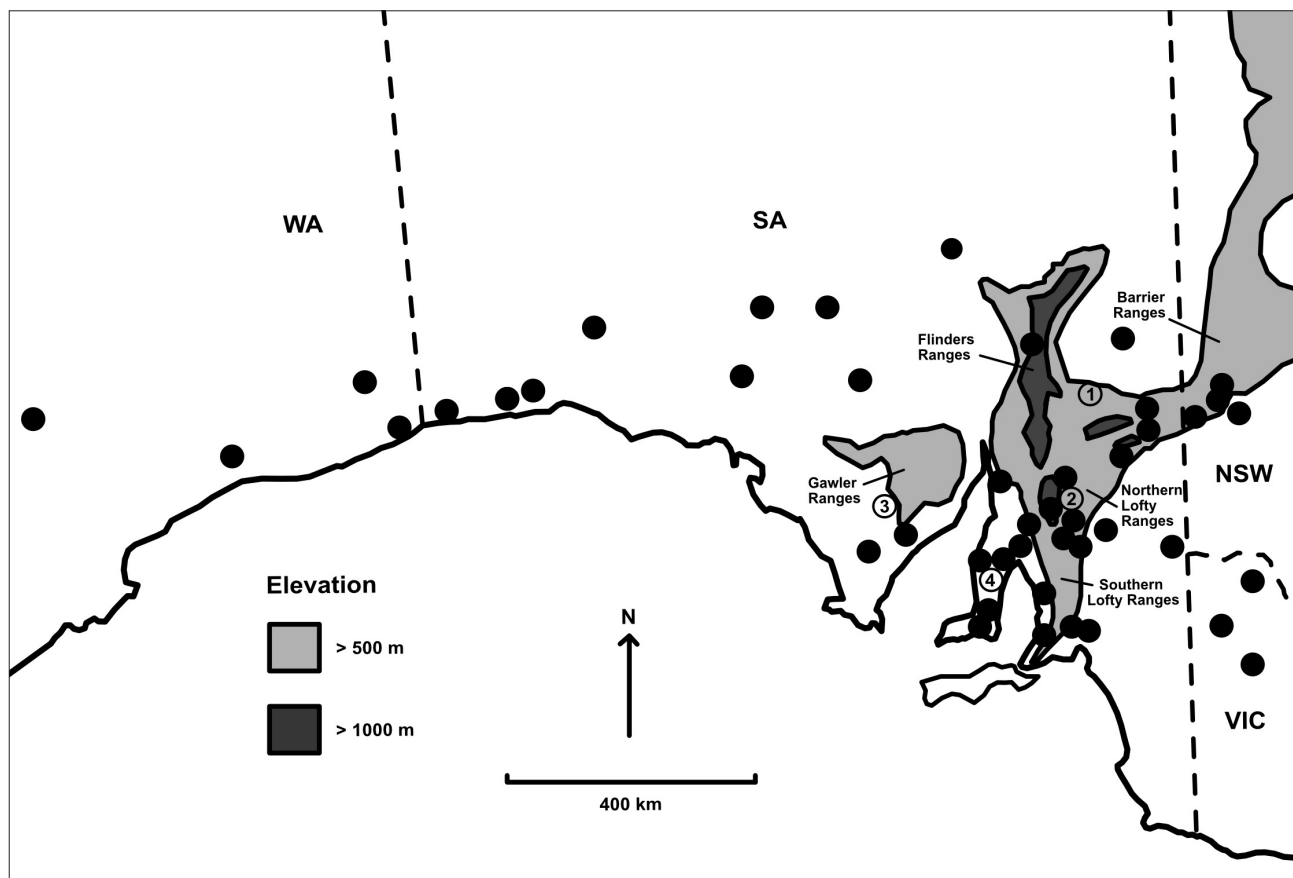
Abele (1959) reported a *pers. comm.* from Enid Robertson that there were a number of distinguishable forms of *D. caespitosa*. Robertson’s unpublished manuscripts showed that she recognised 15 forms within *D. caespitosa*, five of which were later identified as other species, leaving ten forms. Her drawing of her Form 6 is clearly consistent with four specimens that Abele determined to be  $2n=24$ . I believe there is sufficient evidence to separate Robertson’s Form 6 as a separate species, and refer to it hereafter as *Rytidosperma robertsoniae*.

Shortly thereafter, Brock & Brown (1961) carried out hybridization trials between *Danthonia* species of varying ploidy levels. They obtained much of their material from Robertson’s Waite collections (Table 2) and from my examination of the Waite records, it appears that she had supplied seed lines that corresponded with many of her distinct forms (Table 2). Brock and Brown used six seed-lines of  $2n=24$ , including two of the four South Australian *R. robertsoniae* lines, a form from Trangie, and several Canberra lines, which they appear to have collected themselves; these they considered to be functional diploids, 24 being the lowest chromosome number found in the genus in Australia.

Brock & Brown (1961) only gave localities for their material in their Appendix 1, not Waite seed-line numbers, but comparison of their Appendix with the Waite card files of seed lines indicates that at least nine of them were lines that Robertson regarded as typical

**Table 1.** Specimens for which Abele (1959) determined the chromosome number as  $2n=24$ . The number in the left-hand column shows the mapped locations of specimens confirmed as Form 6 in Fig. 1. These specimens were collected for agricultural trials at the Waite Institute and do not seem to have been intended to be placed in the herbarium. They are stored in AD vaults, but have not to date been given AD accession numbers: the only identifiers are codes used during Abele's original research project. Collector names, locations and dates were retrieved from Robertson's card-files.

Fig. 1 reference no.	Collector	Location	Region	Date	Robertson form no.
1	C.M. Eardley (Abele 117A)	Koonamore Stn [N Yunta] SA	North-Eastern	28.vi.1950	6
2	D.E. Symon (Abele 107A)	Terowie Township SA	Northern Lofty	15.vi.1950	6
3	W.C. Johnston (Abele 154A)	Waddikee Rocks [SW Kimba] SA	Eyre Peninsula	2.xi.1950	6
4	A.T. Pugsley (Abele 56)	Arthurton to Ardrossan Road	Yorke Peninsula	23.xi.1950	6
not mapped	R.M. Baker (Abele 114B)	County Jervois	Eyre Peninsula	6.x.1950	specimen not located
not included further	C.W.E. Moore (Abele 110)	Trangie	Central N.S.W.	12.xi.1950	14, <i>R. setaceum</i>



**Fig. 1.** Distribution of *Rytidosperma robertsoniae* in South Australia (SA), the Nullarbor region of Western Australia (WA), north-western Victoria (VIC) and south-western New South Wales (NSW). Circled numbers mark the locations of the four specimens for which Abele (1959) determined the chromosome count as  $2n=24$  (Table 1).

of her distinct forms (Table 2), including two of her *R. robertsoniae* lines. Brock and Brown's hybridization trials showed that crosses between any of the six  $2n=24$  forms (including two lines of *R. robertsoniae*) and any of the  $2n=48$  or  $2n=72$  forms produced only lethal hybrids where the seeds either failed to germinate or the offspring died before flowering. They were able to produce viable (though not fertile) offspring when

crossing their  $2n=24$  forms of *R. caespitosum* (including *R. robertsoniae*) with two other species with  $2n=24$ . In retrospect it is unfortunate that Brock and Brown did not distinguish between Robertson's forms and their other  $2n$  forms in their paper, so that when a cross was viable, it is not possible to link that success to any particular form including *R. robertsoniae*, unless their original data can be found.

**Table 2.** Seed lines of *Rytidosperma* used in hybridization trials by Brock & Brown (1961). Collection details remain unknown for a number of their seed-lines, but they were possibly collected by CSIRO staff.

Brock & Brown location	Waite seed line no.	Collector	Date	Chromosome number (2n)	Robertson form no.
Canberra, A.C.T.				24	
Gilgandra				24	
Cowra				24	
Trangie, N.S.W.				24	
Port Augusta	154A	W.C. Johnston	2.xi.1950	24	6
Terowie, S.A.	107A	D.E. Symon	15.vi.1950	24	6
Canberra, A.C.T.	81?	C.W.E. Moore?	14.xii.1950	48	
Coonabarabran				48	
Forbes				48	
West Wyalong				48	
Cowra				48	
Wagga	93?	C.W.E. Moore	15.xi.1950	48	13
Barraba, N.S.W.	103C		9.xi.1949	48	3
Nyah, Vic.	111A	D.E. Symon		48	
Binnun, S.A.	173B	E.L. Robertson	3.xi.1950	48	2
Peterborough, S.A.	26	R.M. Feuerhardt	23.v.1950	48	9
Robe, S.A.	159B?	E.L. Robertson	3.xi.1950	48	4?
Verdun, S.A.	203A	E.L. Robertson	13.xi.1950	48	15
Mt. Lofty, S.A.	202A?	E.L. Robertson		48	10?
Naracoorte, S.A.	176A?	E.L. Robertson	4.xi.1950	48	5
Doodlakine, W.A.	127	J.L. Frith	15.xi.1950	48	12
Clackline, W.A.	125	J.L. Frith	14.xi.1950	48	11
Canberra, A.C.T.				72	
Cowra, N.S.W.				72	
Ambleside, S.A.	205A	E.L. Robertson		72	
Ungarra, S.A.	206B	A.T. Pugsley		72	

Waters *et al.* (2010, 2011) made collections of 343 whole plants from 28 populations of what they considered to be *Rytidosperma caespitosum* over a wide area in central western New South Wales. Due to difficulty in field identification, other *Rytidosperma* species including *R. erianthum* (Lindl.) Connor & Edgar, *R. fulvum* (Vickery) Humphreys & Edgar, *A. bipartitum* (Link) Humphreys & Linder and *R. setaceum* (R.Br.) Connor & Edgar were also included. They grew the plants on under nursery conditions, and used their seed to produce sibling populations, then used both traditional root-squash examination followed by flow-cytometry to determine their ploidy levels. They found that about 20% of *R. caespitosum* plants were diploid (2n=24), about 60% were tetraploid (2n=48), and 9% hexaploid (2n=72); populations included both diploids and tetraploids. They also found occurrences of a rarer

intermediate triploid ploidy level (2n=36). Waters *et al.* did not report as to whether there were morphological differences between the ploidy levels. They did not conduct hybridization trials to determine if the 2n=36 plants were able to breed back to the other ploidy levels; however they interpreted the existence of these intermediate triploids as evidence of intra- or inter-specific hybridisation of diploid and tetraploid forms and of polyploid races coexisting within a single stable species.

There are now many more specimens from “drier areas” available for examination. I searched all the collections of *R. caespitosum* in both the Western Australian Herbarium (PERTH) and AD, including all the interstate material held at AD, and discovered that *R. robertsoniae* is actually common and widespread

in dry areas of South Australia, and is reliably distinguished from hundreds of specimens of all the other highly variable forms of *R. caespitosum* observed in both herbaria. Even though Brock & Brown (1961) found that hybrids between species invariably showed intermediate characteristics, *R. robertsoniae* is highly consistent and no obvious intermediates between it and any other forms of *R. caespitosum* were found.

## Methods

Dried herbarium specimens were examined from AD and PERTH. A sample of 46 specimens of *R. robertsoniae* representative of different regions of South Australia and all material held from neighbouring states, plus the four Waite specimens (Table 1) was used to derive the description. It is estimated that at least a quarter of specimens in AD currently identified as *R. caespitosum* are actually *R. robertsoniae*.

Data were collected for 87 characters from these 52 specimens of *R. robertsoniae*, some of which were direct measurements, while qualitative characters were assessed on a 1–5 scale. Characters used are shown in the description below. I have used Vickery's (1956) method of measuring the lemma from the sinus to the tip of the callus which is widely followed elsewhere, but it is important to note that Linder's (2005) entry in the *Flora of Australia* does not include the callus in the measurement. Summary statistics of range, minimum and maximum, and standard deviation were calculated in Microsoft Excel. In the descriptions, measurements lie within 2× the standard deviation, and extremes (outside the round brackets) lie beyond 2× the standard deviation.

I visited the Museum of Natural History in Paris (P) and also the Royal Botanic Gardens Kew (K) and examined type material of *Danthonia caespitosum*. There are two specimens in P and one at K. A fourth type-sheet in the Herbarium of the Natural History Museum (BM) was unavailable for examination during my visit to London, but all type specimens are available through JSTOR Global Plants. Measurements from the K and P type specimens were used to identify those specimens in PERTH, which matched the types (see also 'Typification', below).

## Taxonomy

### *Rytidosperma caespitosum* (Gaudich.) Connor & Edgar s.str.

*New Zealand J. Bot.* 17: 325 (1979). — *Danthonia caespitosa* Gaudich., *Voy. Uranie* 4: 408 (1826). — *Notodanthonia caespitosa* (Gaudich.) Zotov, *New Zealand J. Bot.* 1: 117 (1963). — *Austrodanthonia caespitosa* (Gaudich.) H.P.Linder, *Telopea* 7(3): 271 (1997). — **Type citation**: "In Novae-Hollandiae ora occidentali (Baie des Chiens-Marins)". — **Lectotype (here designated)**: Baie des Chiens Marins, Nouv.

Hollande [Shark Bay, Western Australia, 1819], *C. Gaudichaud s.n.* (P00740227). **Isolectotypes**: P00740226 ex Herb. Drake, K000715697 ex Herb. J. Gay, BM000991548 (photo seen).

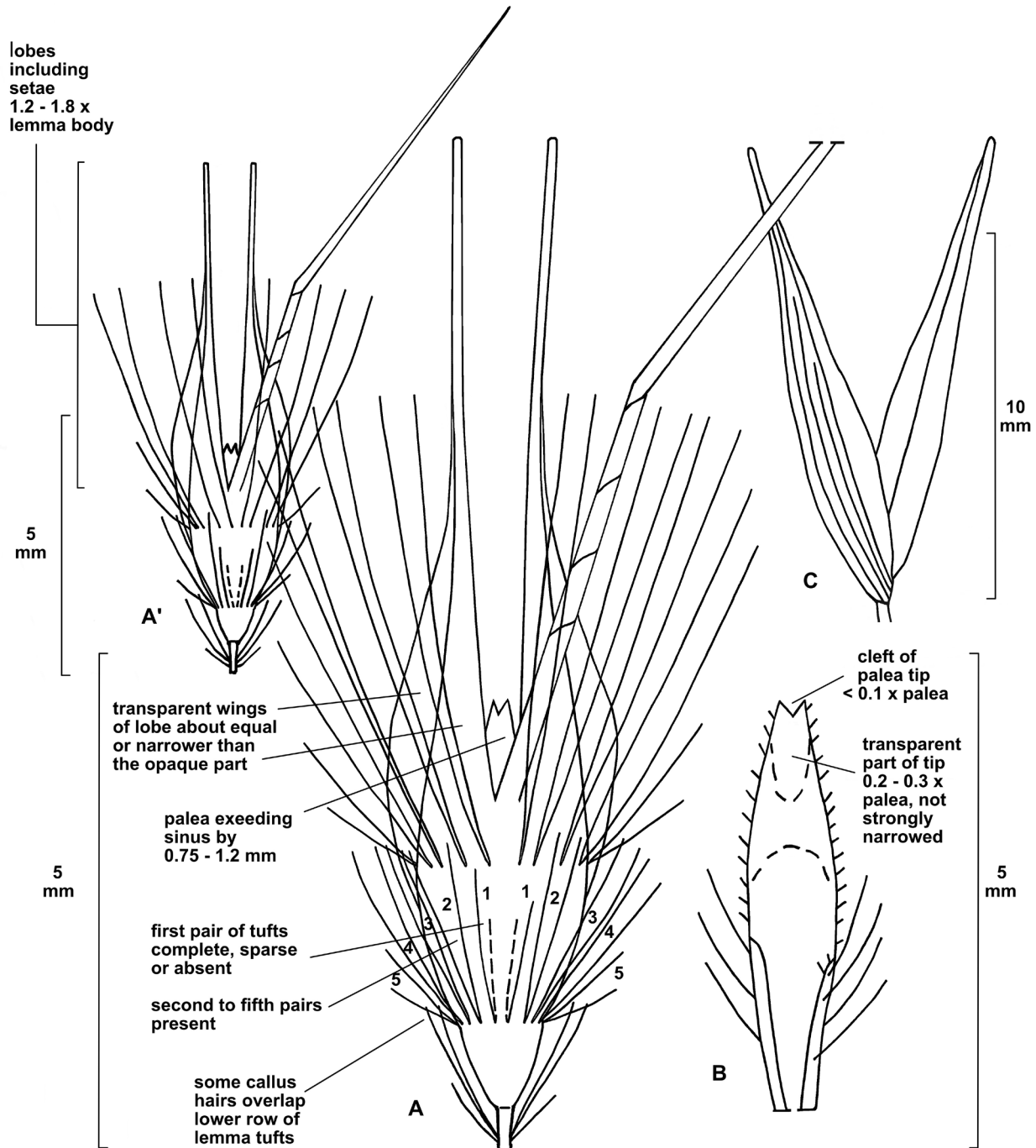
Tuft-forming annual or short-lived perennial grass. *Culms* (8–) 20–50 (–60) cm long, (0.25–) 0.7–1.5 (–2) mm broad, almost smooth to faintly ribbed, without purple flecks, glabrous or very sparsely microscaberulous. *Nodes* purple (brownish if dried when immature), rather waxy. *Basal leaves* 14–30 cm, wavy, glabrous or very sparsely microscaberulous, occasionally with scattered longer hairs 0.1–0.5 mm long, tubercles usually not enlarged, or enlarged and 0.5–0.1 mm broad. *Culm leaves* 2.5–10 cm long, loosely or tightly rolled, 0.5–2 mm broad, upper surfaces moderately to densely hairy, the hairs 0.1–0.5 mm long, densely waxy. *Collar hairs* (2.5–) 3–4 mm. *Ligule hairs* 0.75–1.5 mm. *Sheaths* moderately ribbed above, unpigmented or lightly dotted purple, glabrous or microscaberulous, moderately waxy. *Panicle* not or shortly exerted from the uppermost sheath by 0–3 cm, 3–8.5 cm long, 1.5–2.5 cm broad, lanceolate, oblong or ovate in outline, with 10–30 (–36) spikelets, branches sparsely to moderately pubescent with hairs 0.2–0.6 mm long, green-straw or slightly flecked purple. *Pedicels* 3–4 mm long, straight or slightly curved, moderately pubescent with hairs 0.1–0.3 mm long, green-straw or flecked purple. *Spikelets* 11–17 mm long, with 5 or 6 florets, awns enclosed or exceeding the glumes by up to 3.5 mm. *Lower glume* 11–16 mm long, 2.5–3.5 mm broad, with 5–7 nerves, broad-lanceolate, green-straw or slightly flecked purple above, near glabrous or very sparse microscaberulous above, distinctly narrowed above, with scarios tips 0.5–4.5 mm long, keels scaberulous above, margins 0.75–0.9 mm broad, unpigmented or slightly to moderately streaked purple. *Lemma* 3–4 mm long including callus, 1.3–2.4 mm across the flattened sinus, moderately thick and firm, rounded in cross-section, slightly to moderately convex from sinus to callus, golden-straw when dry, moderately shining, ribs faint to obscure, glabrous on the backs between the rows of tufts, or with a few sparse fine hairs 0.3–0.75 mm long. *Callus* 0.5–0.9 mm long. *Callus hairs* 0.9–1.2 mm long, overlapping the lower row of tufts on the lemma by 0.1–0.2 mm. *Upper row of tufts* of the lemma set 0.6–0.8 mm below the sinus, hairs 3–4.75 mm long, sparse to moderately dense, overlapping the flat lobes by 0.7–1.1 times. *Lower row of tufts* with hairs 1.5–2 mm long, not or well-overlapping the upper row by (–0.3–) –0.2–0.75 mm, rather sparse, the central and sometimes the second pair of tufts next to the midrib often shorter, sparser or entirely absent. *Lobes including setae* 4–7 mm long, 1.2–1.8 times the lemma, flat lobes 1.7–3.25 mm long, 0.75–1.3 times the lemma, moderately ribbed. *Lobe wings* 0.2–0.3 mm broad, usually about the same width as the fleshy lobe or slightly narrower or broader, merging acutely or more gradually into the setae, unpigmented or occasionally lightly to moderately streaked purple. *Setae* 1.5–2.5 mm long, occupying 0.3–0.45 the total lobes, unpigmented or purple. *Central awn shaft* 3.5–8 mm long, exceeding the setae



by 2–7 mm, blotched purple in the middle, sometimes unpigmented. *Column* 2.5–5 mm long, 0.2–0.3 mm broad at the base, not, just reaching or exceeding the flat lobes by (–0.5) 0–0.9 (–1.5) mm, twisted (1–) 2–3 (–4) times, golden-brown to copper-brown. *Palea* 3.25–4 mm long, 0.75–1 mm broad, exceeding the sinus by 0.75–1.2 mm, lanceolate or narrow-ovate, ciliate on the upper third to half of the margins, keel-hairs sparse to moderately dense, 0.5–1.5 mm long, glabrous on the backs between the keels, the backs moderately shining, not to very slightly narrowed but transparent

above for 0.6–1.8 mm, shortly notched at the tip (0.01–) 0.03 (–0.05) of the palea, the transparent part 0.1–0.3 (–0.4) of the total length of the palea measured to the tip of the cleft. *Anthers* c. 0.6 mm long, pale yellow. *Caryopsis* 1.6–1.8 mm long, 0.6–0.8 mm broad, obovate, honey-brown to red-brown, faintly warty on the outer surface, embryonic axis linear to narrow-oval, scutellum narrow-oval to oval.

**Typification.** Gaudichaud cites one gathering of *D. caespitosa* from Shark Bay in the protologue. Vickery



**Fig. 2.** *Rytidosperma caespitosum* lectotype. **A** Lemma, central awn truncated; **A'** lemma at lower magnification with complete central awn; **B** palea; **C** glumes. Five pairs of hair-tufts of the lower row on the lemma back numbered 1 (central) to 5 (lateral), only the outer hairs of each tuft depicted for clarity. — Illustration by the author from: C. Gaudichaud, Baie des Chiens Marins Nouv. Hollande [Shark Bay, Western Australia], 1819 (P00740227).

(1956) lists the “holotype” to be located in P, but does not mention other herbaria. However, there are actually two specimens at P and one each in K and BM (first mentioned by Linder 1997); all four specimens are very similar and apparently from the same gathering. In Vickery’s other descriptions of *Rytidosperma* species (1956), she only ever cites a single specimen as the “holotype”, with any other type material listed as “duplicates”. It seems likely that there was only one specimen available in P to Vickery at the time.

P00740227 is annotated by Gaudichaud, has complete culms with roots still attached and is labelled “syntype”. P00740226 from the herbarium of Emanuel Drake del Castillo, consists only of two panicles, and is likewise labelled “syntype”. K000715697 has three culm fragments and two panicles and is labelled “holotype”; it is from herbarium of Jacques Étienne Gay and marked “Gaudichaud dedid Xbr 1825”, i.e. it was given to Gay by Gaudichaud in that year. BM000991548 has a tuft of fertile culms with some roots attached, plus a separate culm with panicle; it is annotated “recd [received] 1825 from M. Gaudichaud”.

While Art. 9.10 (Turland *et al.* 2018) states that the use of the term “holotype” by Vickery (1956) can be corrected to “lectotype”, it is unclear which of the two specimens at P she actually examined. There are no notes or det-slips by Vickery attached to the specimens. As such, it is necessary to designate a lectotype: I chose P00740227 as the best available specimen, with the other collections being isoelectotypes.

**Note.** The only PERTH specimens matching the type collection of *D. caespitosa* are restricted to the Shark Bay area. The type form is distinguished from all other material of *R. caespitosum* that I have examined so far in PERTH and AD by having only shortly elongated lobes including setae, only 1.3–1.8 times the lemma, the only consistent difference, but a very important one in a genus where the relative lengths of parts are often diagnostic. In all other forms of *R. caespitosum* examined, the lobes including setae are at least twice the length of the lemma.

Gaudichaud’s original Latin description is, as was then commonly accepted, very brief, and, in the years since, published descriptions of *R. caespitosum* have been much expanded by other authors over the years, in an attempt to encompass the high level of variation in what is currently recognised as *R. caespitosum*. I considered it useful to provide a description of *R. caespitosum* *s.str.*, based on my measurements of P00740227 and eight other specimens from the Shark Bay region in PERTH. The description and illustration will be indispensable should any further segregation of taxa from *R. caespitosum* be carried out in the future.

It is even more important to have a detailed drawing (Fig. 2) and description of the lectotype, because all three type specimens I have seen are suffering from an identical form of gelatinous deterioration, presumably

relating to their being subject to some form of contamination. That they are all suffering the same deterioration tends to confirm that the four specimens are duplicates, with the contamination occurring before the original collection was divided.

### *Other specimens examined*

WESTERN AUSTRALIA: *J.J. Alford & M. Trudgen 1369*, Three Bays Island, Shark Bay, 14.ix.1989 (PERTH01451685A); *J.J. Alford & M. Trudgen 1271*, Salutation Island, Shark Bay, 12.ix.1989 (PERTH01451162); *T.E.H. Aplin 3475*, Heirisson Prong [Cape Harrison], Shark Bay, 13.viii.1970 (PERTH00293199); *A. Markey 1825*, Edelland, Shark Bay, 18.ix.1997 (PERTH05252415); *A. Markey 1716*, Steep Point, Shark Bay, 20.ix.1997 (PERTH05249295); *A. Markey 1736*, -12 km S-SSW Useless Loop Town & Trig, Shark Bay, 28.ix.1997 (PERTH05249120); *A.S. George s.n.*, East Fisherman Paddock, Dirk Hartog Island, Shark Bay, 4.ix.1972 (PERTH00293121A); *P. Morat 8338*, False Entrance, Shark Bay, 24.vii.1988 (PERTH01780514).

### *Rytidosperma robertsoniae* Tiver, *sp. nov.*

**Holotypus:** SW Kimba, Eyre Peninsula Region, South Australia, 15 Oct. 1953, *J.G.[B.] Cleland s.n.* (AD97222040). **Isotypi:** CANB, MEL, NSW, PERTH, K. — This collection is the basis of seed-line ELR 154A, used by Abele (1959) and Brock & Brown (1961), i.e. the chromosome number is known to be  $2n=24$ .

*Danthonia caespitosa* Form 6: E.L.Robertson in K.Abele, *Trans. Roy. Soc. S. Austral.* 82: 163–173 (1959). 24-chromosome race.

*Danthonia caespitosa*  $2n=24$ : R.D.Brock & J.A.M.Br., *Austral. J. Bot.* 9(1): 62–91 (1961).

*Danthonia caespitosa* *auct. non* Gaudich.: A.P.C.Renfrey in Jessop & Toelken, *Fl. S. Austral.* 4: 1858 (1986), partly.

*Nothodanthonia caespitosa* *auct. non* (Gaudich.) Zotov: Zotov, *New Zealand J. Bot.* 1: 117 (1963), partly; H.P.Linder & Verboom, *Telopea* 6(4): 615 (1996), partly.

*Austrodanthonia caespitosa* *auct. non* (Gaudich.) H.P.Linder: H.P.Linder, *Telopea* 7: 271 (1997), partly; H.P.Linder in K.Mallett, *Fl. Austral.* 44B: 53 (2005), partly; Jessop *et al.*, *Grasses S. Austral.* 287 (2006), partly.

*Rytidosperma caespitosum* *auct. non* (Gaudich.) Connor & Edgar: Connor & Edgar, *New Zealand J. Bot.* 17: 325 (1979), partly.

Tuft-forming annual or short-lived perennial grass. *Culms* short to medium height, occasionally dwarfed, rarely tall, (11–) 18–32 (–44) cm long, (0.5–) 0.6–1 (–1.4) mm broad (measured shortly below node to avoid destroying sheaths to obtain lower measurements), slightly ribbed, flecked purple especially near nodes, glabrous or sparsely scabrid. *Nodes* purple to dark-purple. *Basal leaves* (1–) 5–16 (–26) cm long (sheath and blade), strongly sinuate to falcate, unpigmented or slightly streaked purple near tips, with sparse to moderately dense hairs, (0–) 0.25–1.9 (–2.5) mm

long, hairs usually with enlarged tubercle-bases, 0.05–0.2 mm broad, occasionally glabrous. *Culm leaves* (1–) 2.5–8.5 (–13) cm long, tightly rolled when dry, (0.3–) 0.4–0.9 (–1.3) mm broad, upper surfaces moderately to densely pubescent with hairs (0–) 0.1–0.7 (–1.5) mm long. *Collar hairs* (1.25–) 2–3.5 (–5) mm long. *Ligule* a fringe of hairs, longest hairs (0.5–) 0.6–1.1 (–1.5) mm. *Sheaths* sparsely scabrid or occasionally with hairs, 0.1–2.5 mm long, on enlarged tubercles, 0.05–0.1 mm broad, moderately ribbed above, unpigmented or lightly streaked purple. *Panicle* not or shortly exerted from sheath at seed maturity by 0–5.5 (–13) cm, panicle (3–) 4–7 (–8.5) cm long, (1.5–) 2–3.5 (–4) cm broad, ovate, oblong or broad-lanceolate in outline, with (5–) 7–17 (–35) spikelets, branches sparsely to moderately pubescent with hairs 0.1–0.5 mm long, unpigmented or slightly to moderately streaked purple. *Pedicels* (3.5–) 4.5–7.5 (–10) mm long, straight or slightly curved, pubescent with hairs 0.1–0.75 mm long, with longer hairs above to 1.2 mm long, slightly to quite densely streaked purple. *Spikelet* (14.5–) 19.5–25 (–28) mm long including setae, with (5–) 6–8 (–9) florets, setae exceeding glumes in spikelet by 1–6 (–8) mm. *Lower glume* with (3–) 4–6 (–9) veins, (14–) 16–21 (–25.5) mm long, 3–4 (–5) mm broad, broadly lanceolate, moderately to abruptly narrowed above, with scarious tips (0–) 1.5–4.5 (–8) mm long, glume-body yellowish often slightly purple-streaked, glabrous or sparsely scabrid, keels sparsely tuberculate or shortly scabrid in upper third. *Membranous glume-margins* 0.7–2 mm broad, streaked purple half or full length of margin, occasionally unpigmented. *Upper glume* lanceolate or more often broad-lanceolate, opaque bodies nearly always flecked or streaked purple, slightly to abruptly narrowed above, upper glume margins 1–1.4 mm broad, frequently streaked or blotched purple, very rarely unpigmented. *Lemma* (3–) 2.5–4.5 (–5) mm long from sinus to tip of callus, c. 2 mm broad at sinus, narrow-oblong to narrow-triangular, broadest point across sinus, well-rounded to somewhat compressed in cross-section, moderately to strongly indurated, yellowish to golden, shining, mid-rib of lemma faint to slightly raised, lateral ribs obscure to faint, surface between the two rows of hair-tufts always completely glabrous. *Hairs of upper row of tufts* (below sinus) set (0.4–) 0.5–0.7 (–0.9) mm below sinus, (3–) 4–5.3 (–6) mm long, partially overlapping by (0.35–) 0.5–0.7 (–0.9) flat part of lemma lobes, hair-tufts complete (all 8 dorsal tufts present), moderately to very dense with many hairs, but often with quite a few shorter hairs. *Tufts of lower row of hairs* (above callus) interrupted, first pair of tufts next to midrib totally absent or rarely reduced to a few very short bristles, second pair of tufts moderately to very densely hairy and raised on distinct ledge-like protuberances of the lemma back, third pair complete, reduced and set higher than the other tufts, or absent, fourth pair moderately to very dense and raised on distinct protuberances, hairs of the four dense tufts, (1–) 1.6–2.5 (–3) mm long, most of the hairs very short and not reaching, or some hairs just reaching, or slightly overlapping upper row of tufts. *Callus* (0.5–) 0.6–1 (–1.25) mm

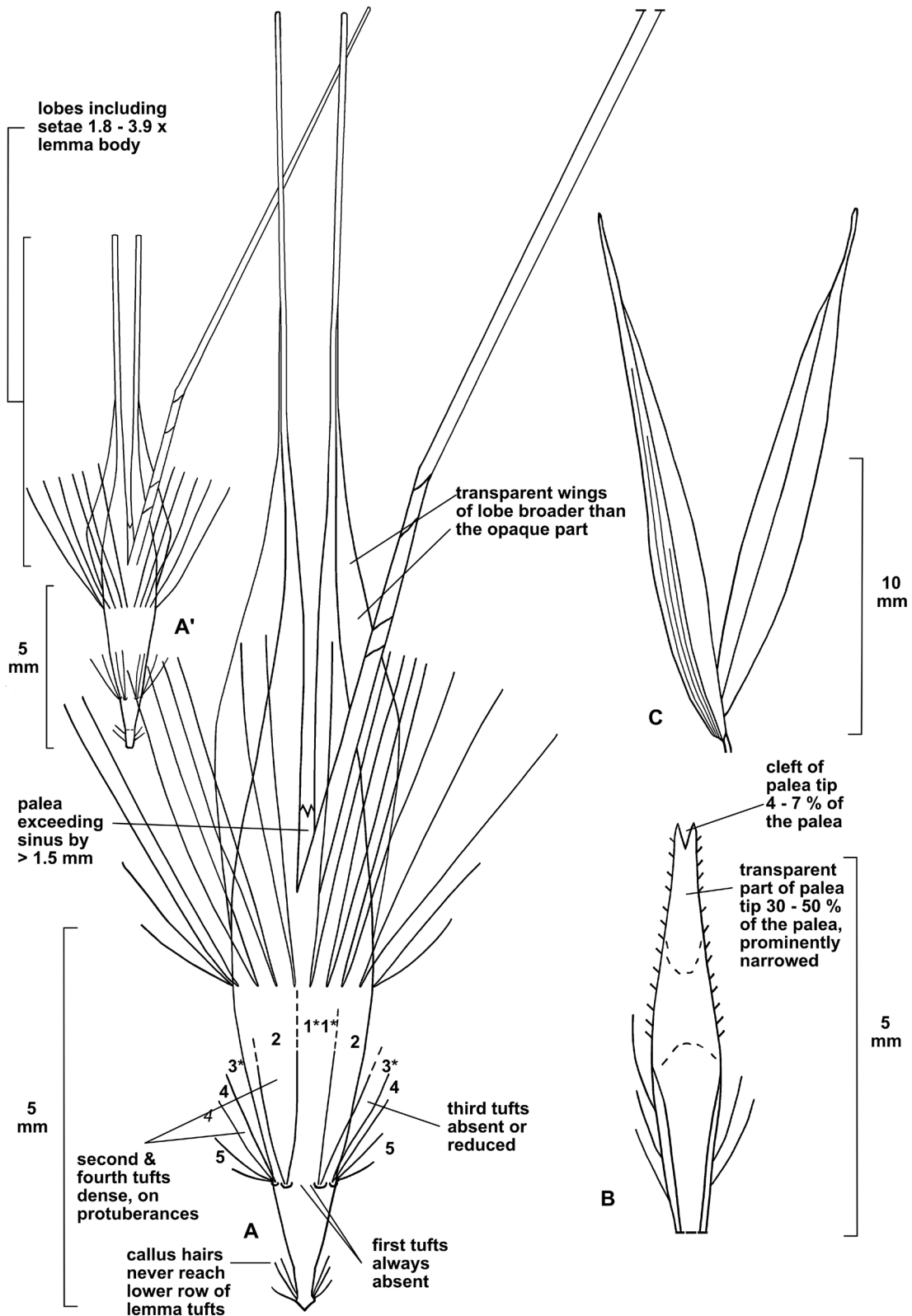
long, with hair-tufts (0.5–) 0.7–1.2 (–1.6) mm long, hair-tufts barely as long as callus and never reaching row of tufts above callus, falling short of it by (0.15–) 0.22–0.45 (–0.6) mm. *Lateral lemma lobes* (including setae) (7–) 9–13 (–14.5) mm long, (1.8–) 2.3–3 (–3.9) times as long as lemma, flat part of lobes (1.1–) 1.3–1.7 (–1.9) times as long as lemma, moderately to prominently ribbed, unpigmented or somewhat flecked purple above. *Setae* (2.5–) 3.5–6 (–8.5) mm long, occupying (0.25–) 0.4–0.5 (–0.6) the length of the total lobes, moderately flecked to dark purple. *Membranous (nerved) lobe wings* (0.2–) 0.4–0.6 (–0.75) mm broad at their widest point and usually slightly broader or much broader than the opaque (innervated) part of the lobe, narrowing acutely to rather abruptly into the setae, commonly streaked purple, occasionally unpigmented. *Central awn & column* (12.75–) 15–20.5 (–26) mm long. *Awn shaft* (8.5–) 10–14 (–18) mm long, streaked purple for at least half its length, rarely unpigmented, exceeding setae by (4.8–) 6–9 (–14) mm. *Awn column* (4.25–) 5–6.5 (–8) mm long, either shorter by up to 3 mm or longer by up to 3 mm than the flat part of the lobes, (0.2–) 0.3–0.4 mm wide across its base at the sinus, twisted (2–) 2.5–4 times, golden-brown to dark-brown at maturity. *Palea* narrow-lanceolate or narrow-elliptic, (4–) 4.5–5.8 (–6.5) mm long, (0.75–) 0.9–1.1 (–1.35) mm broad at the widest point which is (0.3–) 0.4–0.6 (–0.7) of the total length, exceeding sinus by (0.75–) 1.5–2.4 (–2.9) mm, reaching up to (0.1–) 0.25–0.4 (–0.55) of the flat lobes, the tip deeply cleft, the teeth (0.3–) 0.04–0.07 (–0.8) of the palea, distinctly narrowed above the caryopsis into a long transparent tip (0.25–) 0.3–0.5 (–0.6) of the length, keel-hairs sparse to moderately dense, (1–) 1.2–1.8 (–2.5) mm long, surface between keels glabrous and highly shining, apex bifid with cleft 0.2–0.35 (–0.6) mm deep. *Anthers* (1.2–) 1.5–2.3 (–2.5) mm long, commonly pale to dark-purple, occasionally pale gold (possibly when immature). *Caryopsis* obovate, (0.4–) 0.6–1 (–2.3) mm long, (0.4–) 0.6–1 (–1.2) mm broad, honey to red-brown, faintly warty on adaxial surface, embryonic axis narrow-oval, scutellum narrow-oval to oval.

**Distribution and Habitat.** Abele (1959) suggested that *R. robertsoniae* is most common in drier environments, and the distribution of the specimens examined supports his comment (Fig. 1). This statement is also supported by the observations of Waters *et al.* (2010) in New South Wales, where diploids were associated with a lower mean annual rainfall for a number of *Danthonia* species. It is currently recognised from across the drier regions of southern Western Australia and South Australia and from Broken Hill in New South Wales to north-western Victoria. It is notably absent from the higher rainfall regions and more mesic habitats of the South Australian ranges. The area that *R. robertsoniae* inhabits is associated with Oligo-Miocene marine incursions of the Eucla and Murray basins (Quigley *et al.* 2010). The Eucla Basin once covered the area we now know as the Nullarbor Plain, and also coastal regions of Eyre Peninsula, all of Yorke Peninsula, and



the Adelaide plains. The Murray Basin abutted the eastern side of the Flinders Ranges, and extended into south-west New South Wales and north-west Victoria. The soils of these regions are, being of marine

origin, solonized (saline) calcareosols (limestone) and alkaline (Isbell 2002). The specimens listed below for *R. robertsoniae*, where ecological information is given, were found on solonized heavy clays, clays,



**Fig. 3. *Rytidosperma robertsoniae*.** A lemma, central awn truncated; A' lemma at lower magnification with complete central awn; B palea; C glumes. Locations of five pairs of hair-tufts of the lower row on the lemma back numbered 1 (central) to 5 (lateral), only the outer hairs of each tuft depicted for clarity. Absent tufts indicated by asterisks. — Illustration by the author from: W.C. Johnston, Waddikee Rocks, 2.xi.1950 (AD).



and calcareous sandy loams of inland plains, inland limestone ridges and outcrops, in limestone crevices of coastal cliffs, and in one case on a gypsum dune (D.E. Symon & J. Symon 16660). That *R. robertsoniae* can thrive in these harsh soils and climates indicates a tolerance to high levels of aridity, alkalinity and salinity not found in most other species of *Rytidosperma*. This level of ecological specialization is further evidence of the likelihood that *R. robertsoniae* is a separate species from other forms of *R. caespitosum*. It is likely that *R. robertsoniae* is more common in neighbouring states than these results, mostly based on South Australian herbarium material, indicate.

**Phenology.** Specimens with mature spikelets have most often been collected between August and December, peaking in September, indicating that the species derives from sites showing a typical winter rainfall pattern. However, fertile specimens have been collected in April and June, suggesting that *R. robertsoniae* can take advantage of seasonal conditions, and may behave as a short-lived perennial if conditions allow.

**Conservation Status.** *Rytidosperma robertsoniae* appears to be common and widespread, and its conservation is probably not at any immediate risk. However, land clearance, especially in the southern part of its range, would have resulted in fragmentation of its population. If land rehabilitation is carried out in these areas, it would be useful to be able to identify if *R. robertsoniae* was originally the dominant form, because re-seeding with other species or forms of *Rytidosperma* may not be successful in alkaline, saline soils inhabited by *R. robertsoniae*.

**Etymology.** The specific epithet is in honour of Mrs Enid Robertson who, as systematic botanist at the Herbarium of the Waite Agricultural Institute in the 1950s, first recognised *R. robertsoniae* as a distinct form.

**Distinguishing characteristics of *Rytidosperma robertsoniae*.** The description of *R. robertsoniae* is based on the four specimens of Robertson's Form 6 and 46 other specimens. They were consistent in the following characters, in which they are distinguished from *R. caespitosum* s. str. and all other forms seen of *R. caespitosum*.

(1) **Reduction in number of hair-tufts of the lower row of the lemma and raising of the remaining tufts on protuberances.** One of the Abele specimens of *R. robertsoniae* is illustrated in Fig. 3. The specimen confirms what Abele (1959) recorded in his drawing: this 24-chromosome plant has a reduced number of hair-tufts in the lower row of the two rows of hairs across the backs of the lemma commonly seen in *R. caespitosum*. A *Rytidosperma* lemma has nine nerves and, even if the nerves themselves are obscure because of thickening of the lemma, they govern where the tufts occur, i.e. between the ribs; in a specimen with a complete row of tufts, there are eight dorsal tufts plus two lateral

tufts, i.e. 5 pairs of tufts on each side of the mid-rib (central nerve) (Fig. 2). In *R. robertsoniae* the first pair of tufts, next to the midrib, is absent and the second pair, out from the midrib, is very dense and each tuft is raised on a distinct protuberance (Fig. 3). The third pair may be complete, sparse or absent. The overall appearance is distinctive, of apparently four or six very dense tufts, with a gap where the two central tufts are absent, and sometimes two other gaps where the third tufts are absent. When both the central and third tufts are absent, the remaining tufts are often very short, giving a very distinctive appearance. Very occasionally, the central pair of tufts are not entirely absent, with one or both of the tufts replaced by a few very short bristles.

Taken by itself, a reduced number of hair-tufts in the lower row of tufts of the lemma is not always diagnostic in separating *R. robertsoniae* from the rest of the widespread and variable *R. caespitosum*; the lectotype of *R. caespitosum* also has two very sparse, nearly absent, central tufts (Fig. 2) and I have noticed other specimens of *R. caespitosum* s. lat. where the tufts are sparse or nearly absent in both the lower and (less frequently) the upper row. However, in *R. robertsoniae*, the combination of one or two pairs of tufts being absent with the remaining tufts being very dense and raised prominently on protuberances (see below) is diagnostic.

(2) **Hair-tufts of the callus.** Another diagnostic feature of *R. robertsoniae* relates to the pair of hair-tufts arising from the callus. In all other forms of *R. caespitosum* seen, including the type material (Fig. 2), at least some of the callus hairs are long enough to overlap the lower row of hair-tufts on the lemma-back; however, in *R. robertsoniae*, the callus hairs are very short, often not reaching the junction of the lemma and callus, and never reaching the base of the lower row of hair-tufts on the lemma-backs (Fig. 3A).

(3) **Palea.** In *R. robertsoniae* the palea long exceeds the sinus of the lemma (where the two lateral lobes meet), usually by at least 1.5 mm (Fig. 3). This in itself is not diagnostic as some other forms of *R. caespitosum* s. lat., have paleas long-exceeding the sinus, though the type form has the palea only shortly or moderately exceeding the sinus by 0.75–1.2 mm. Diagnostically, comparative to the type form of *R. caespitosum*, the upper part of the palea, above where the caryopsis sits, is narrowed and drawn out into a long transparent tip, occupying (0.25–) 0.3–0.5 (–0.6) of the length of the palea, measured to the tips of the cleft. The tip of the palea is also more deeply cleft than other forms of *R. caespitosum*, (0.03–) 0.04–0.07 (–0.08) of the palea. In *R. caespitosum* s. str. the cleft at the tip of the palea is shallow, about 0.03 of the palea, and the transparent part is short or of moderate length, 0.2–0.3 (–0.4) times the length of the palea.

- (4) **Lobe wings.** The membranous lobe wings of the lateral lobes of the lemma are very broad in *R. robertsoniae* (Fig. 3). The lectotype of *R. caespitosum* (Fig. 2), and most other forms of *R. caespitosum*, have lobe wings that are usually about equal to or narrower than the width of the opaque part of the lobe, whereas in *R. robertsoniae*, the lobe wings are usually noticeably broader than the opaque part of the lobe at their widest point. The broad lobe wings of *R. robertsoniae* have occasionally led to mis-identifications as *R. laeve* (Vickery) Connor & Edgar, which also has broad lobe wings, but is distinguished by a much broader palea.
- (5) **Length of Lobes.** In *R. robertsoniae* the lateral lobes, including the lateral awns (setae), are elongated, 1.8–3.9 times the length of the lemma body. There is a wide range of elongation of the lateral lobes in *R. caespitosum s.lat.*, even approaching the extreme elongation seen in *R. setaceum*. However the type form of *R. caespitosum* is distinctive in having comparatively short lateral lobes, 1.2–1.8 times the length of the lemma body. In this regard, *R. caespitosum s.str.* approaches the appearance of *R. tenuius*, but has a narrower palea and lacks the hairiness of the palea between the keels.
- (6) **Cytology.** *Rytidosperma robertsoniae* has the chromosome number,  $2n=24$ , whilst the majority of other specimens of *R. caespitosum s.lat.* are  $2n=48$ , with occasional  $2n=72$  (Abele 1959). *Rytidosperma robertsoniae* is one of a number of species in the genus with chromosome number  $2n=24$ , and it has been shown to be capable of producing viable offspring when crossed with *R. racemosum* and *R. auriculatum* (Brock & Brown 1961). It is therefore possible that *R. robertsoniae* is a parent of one or more of the many forms of *R. caespitosum* with  $2n=24$ . Molecular work might be able to establish if this is the case.

**Other specimens examined (in addition to the specimens listed in Table 1)**

WESTERN AUSTRALIA. **Nullarbor:** *T.E.H. Aplin & M. Trudgen 5742*, Railway, 175.5 miles [282 km] E Kalgoorlie, vi.1974 (PERTH00284998); *A.C. Beauglehole ACB 49417*, 19 km W Eucla, 30.viii.1974 (PERTH00294667); *R. Davis 9229*, 37 km NW Cocklebiddy, 5.vi.2000 (PERTH 05921651); *A.S. George 8490*, 20 miles [32 km] SW Reid, 14.x.1966 (PERTH00295108).

SOUTH AUSTRALIA. **Lake Eyre:** *R.J. Bates 35142*, Mount Hamilton, 6.xi.1993 (AD99426238). **Nullarbor:** *R.J. Chinnock 1188*, Eyre Highway, 15 km E Koonalda, 20.ix.1973 (AD97346388); *A. Robinson NPNU-7503*, 21 km NW Nullarbor Station, 21.ix.1984 (AD98526024); *H.R. Toelken 7757*, Highway, 42.7 km W Nullarbor, 29.ix.1987 (AD98747090); *D.J.E. Whibley 4510*, Eyre Highway, 40 km E SA-WA Border, 27.x.1974 (AD97506131). **Gairdner-Torrens:** *R.J. Bates 32019*, Garden Well Island [Lake Gairdner], 10.iv.1993 (AD99336340); *R.J. Bates 50031*, Hill off Tarcoola Road, 14.iv.1998 (AD100872); *H. Vonow & N. Neagle GS721-241*, Bon-Bon to Mt Eba Road, 26.x.2010

(AD241644). **Flinders Ranges:** *R.J. Bates 22926*, Dawson Range [N Peterborough], 13.iv.1990 (AD99026113); *S.T. Blake 16901*, Near Blinman, 31.viii.1946 (AD96942419); *J.B. Cleland s.n.*, ~10 km E Port Germein, 15.ix.1942 (AD96228264). **Eastern:** *R.J. Bates 41213*, near Olary, 2.x.1995 (AD99744081); *J.B. Cleland s.n.*, Oakbank Station [E Burra], 12.ix.1968 (AD96903005); *R.L. Crocker s.n.*, Poalka Paddock, Bimbowrie Station [NE Yunta], 23.ix.1939 (AD98591949); *T.G.B. Osborn s.n.*, Mt Victor Paddock, Koonamore Station, 12.xii.1924 (AD97741269); *SA Pastoral Board s.n.*, Dlorah Downs Station [E Yunta], 1.xi.1956 (AD97916002). **Eyre Peninsula:** *K. Alcock 2429*, Hundred of Rudall, Hincks National Park, 13.xi.1968 (AD96922395); *F.J. Badman 4549*, Carriewerloo Bluff, 23.ix.1990 (AD99052153); *K.L. Graham, H. Stewart & N. Cotsell BS131-461*, Hincks Conservation Park, 8.2 km ESE Tooligie, 2.xi.2001 (AD129102); *L. Heard & G. Carpenter BS131-203*, Hincks Conservation Park, 9 km SSE Tooligie, 3.xi.2001 (AD128694). **Northern Lofty:** *R.J. Bates s.n.*, Bundaleer Forest, 1.xi.1983 (AD99427041); *D. Murfet & L. Heard BS49-375*, Swampy Flat Road, Hanson, 22.x.1992 (AD99532585); *N.M. Smith 2763*, 26 km E Lochiel, 4.viii.1991 (AD99145143); *J. Turner & A. Brown BS162-3348*, 5.2 km WNW Yacka, 3.xi.2004 (AD186513). **Murray:** *J. Carrick 3679*, Near Mallee View Homestead, Monarto, 30.ix.1974 (AD97443119); *J.B. Cleland s.n.*, Chauncy's Line [SW Callington], 12.x.1938 (AD96228258); *D.D. Cunningham, H. Vonow & R. Ferguson 1373*, Hopkins Creek [SW Burra Gorge], 11.xi.2003 (AD161478); *E.H. Ising s.n.*, Koomooloo Stn [NE Burra], 24.ix.1937 (AD97805248); *L.A. Malcolm & K.L. Graham BS62-2537*, 11.3 km NNE Mount Bryan East, 24.x.1994 (AD99717263). **Yorke Peninsula:** *D.A. Cooke 613*, Curramulka to Ardrossan Road, 28.x.1991 (AD99152117); *H. Short s.n.*, Port Moorowie, 17.xi.2010 (AD244610); *D.E. Symon s.n.*, Near Norris Property, Paskeville, 8.x.1952 (AD98591821); *D.E. Symon & J. Symon 16660*, Lake Fowler [N Moorowie], 7.xi.2001 (AD123389); *D.J.E. Whibley 8194*, Dowling Drive, Port Hughes, 9.ix.1982 (AD98238428). **Southern Lofty:** *J.B. Cleland s.n.*, Pedlar's Creek, Noarlunga, 15.x.1927 (AD96228291); *J.B. Cleland s.n.*, Marino Cliffs, 8.x.1932 (AD96225149); *D.J.E. Whibley 8753*, Aldinga Bay, 3.ix.1983 (AD98402260); *Anon. s.n.*, Roseworthy Agricultural College, xii.1931 (AD966072511). **NEW SOUTH WALES. Western:** *E.C. Andrews s.n.*, Broken Hill, ix.1918 (AD98529272); *P.L. Milthorpe 512*, Ophara [SW Broken Hill], 1.ix.1971 (AD97242126); *E.R. Reed 9*, Vicinity of Broken Hill, 1921 (AD97327076); *L. Richley 1128*, Menindee Road from Broken Hill, 5.ix.1973 (AD97405170). **VICTORIA. North-West:** *M.D. Crisp 3293*, 30 km SSW Mildura, 9.x.1977 (AD97834068); *M.G. Corrick & P.S. Short 6605*, 5 km SW Sunset Tank, 28.ix.1980 (AD98051013); *A.C. Beauglehole & E.W. Finck 29307*, Wyperfield National Park, 1.ix.1973 (AD98015019).

## Discussion

There are now a great many more, and a better geographic spread, of specimens of *R. caespitosum* available in herbaria than were available to Vickery (1956), Robertson (unpubl.), Abele (1959) and Brock & Brown (1961). Vickery (1956) seems to have examined all the specimens available in Australian herbaria at that time,

## Alterations required to published keys to distinguish *Rytidosperma robertsoniae*

Additional couplets required are marked with the suffix 'a'.

The entry for *Rytidosperma* (syn. *Austrodanthonia*) in the *Flora of Australia* (Linder 2005) becomes:

- 27:** Glumes only slightly longer than florets, 3.5–4 mm wide . . . . . **27a**  
**27a:** Hair-tufts of the lower row next to the central rib absent, remaining tufts very dense,  
 raised on distinct protuberances . . . . . ***R. robertsoniae***  
**27a:** Hair-tufts of the lower row complete or, if absent, then remaining tufts not very dense  
 nor raised on protuberances . . . . . ***R. caespitosum s.lat.***

For South Australia, the entry for *Grasses of South Australia* (Jessop et al. 2006) becomes:

- 9.** Palea narrow-lanceolate and usually much exceeding the sinus . . . . . **9a**  
**9:** Palea broadly obovate to oblanceolate, only shortly exceeding the sinus . . . . . **10**  
**9a:** Hair-tufts of the lower row next to the central rib absent, remaining tufts very dense,  
 raised on distinct protuberances . . . . . ***R. robertsoniae***  
**9a:** Hair-tufts of the lower row next to the central rib complete or, if absent, then remaining tufts  
 not very dense nor raised on protuberances . . . . . ***R. caespitosum s.lat.***

This key also requires modification at couplet 4 to avoid confusing *R. robertsoniae* with *R. laeve*:

- 4.** Lemma without a complete row of tufts above the callus . . . . . **4a**  
**4:** Lemma with a complete row of tufts above the callus . . . . . **5**  
**4a:** Remaining tufts sparse or absent . . . . . ***R. laeve***  
**4a:** Remaining tufts dense and raised on distinct protuberances . . . . . ***R. robertsoniae***

which numbered about 230. She spent considerable effort trying to isolate subspecies of *R. caespitosum*, but was unable to do so, even though she found 'extreme forms' that she deemed worthy of taxonomic distinction, considering the level of delineation between other species already described in the genus.

If Robertson (unpubl.) was correct, and there are ten or more recognizable forms of *R. caespitosum*, 230 specimens may simply not have been enough to enable Vickery to identify any but a few specimens of the most common forms. At the time of writing, there were 4,403 specimens of *R. caespitosum* in Australian Herbaria (AVH 2018), which is a substantial increase over the number of specimens available to Vickery in 1956. This increase has enabled me to locate enough specimens from dry areas to establish consistent characters and describe *R. robertsoniae*. The distinctive features of *R. robertsoniae*, and its wide distribution across four states, including both sides of the Nullarbor, would suggest that it is a separate species of some antiquity.

A numerical morphological analysis applied to a larger and more geographically even data-set may enable the identification of other forms of *R. caespitosum* that warrant taxonomic recognition.

## Acknowledgements

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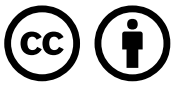
of South Australia (AD): Helmut Toelken, Helen Vonow, Bill Barker, Robyn Barker, Graham Bell, Brian Moore, Rosemary Taplin, Jürgen Kellermann; Western Australian Herbarium (PERTH): Karina Knight, Terry Macfarlane; National Herbarium of Victoria (MEL): Graeme Lorrimer; The Herbarium of the Royal Botanic Gardens, Kew (K): Clare Drinkell; Muséum national d'histoire naturelle, Paris (P): Thomas Haevermans.

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