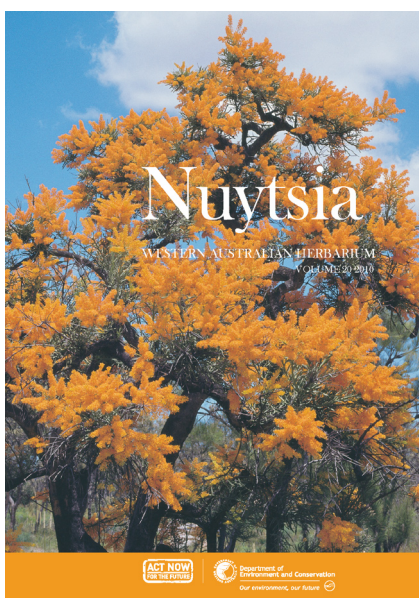


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All enquiries and manuscripts should be directed to:

The Managing Editor – *NUYTSIA*
Western Australian Herbarium
Dept of Environment and Conservation
Locked Bag 104 Bentley Delivery Centre
Western Australia 6983
AUSTRALIA

Telephone: +61 8 9334 0500
Facsimile: +61 8 9334 0515
Email: nuytsia@dec.wa.gov.au
Web: science.dec.wa.gov.au/nuytsia



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Re-evaluation of *Ptilotus polystachyus* sens. lat. (Amaranthaceae) and creation of the new combination *Ptilotus giganteus*

Robert W. Davis and Ryonen Butcher

Western Australian Herbarium, Department of Environment and Conservation,
Locked Bag 104 Bentley Delivery Centre, Western Australia 6983

Abstract

Davis, R.W. & Butcher, R. Re-evaluation of *Ptilotus polystachyus* sens. lat. (Amaranthaceae) and creation of the new combination *Ptilotus giganteus*. *Nuytsia* 20: 217–227 (2010). This paper evaluated infraspecific taxa in *Ptilotus polystachyus* (Gaudich.) F.Muell. using morphometric analysis. We conclude that var. *arthrotrichus* Benl should not be regarded as a distinct variety from var. *polystachyus* and that var. *longistachyus* (W.Fitzg.) Benl and var. *pullenii* (Benl) Benl should be merged into a single taxon and elevated in rank to species. The new combination *P. giganteus* (Cunn. ex Moq.) R.W.Davis & R.Butcher is erected for this taxon. With these changes, *P. polystachyus* is now regarded as a widespread and variable species without infraspecific taxa. Revised descriptions are presented for these two species.

Introduction

This paper is a part of a series dealing with appropriate ranks for Western Australian infraspecific taxa within *Ptilotus* R.Br., in preparation for the *Flora of Australia* treatment of Amaranthaceae. The paper examines the differences among the current varieties of *P. polystachyus* (Gaudich.) F.Muell. sens. lat. using morphometric analysis, and establishes the new combination *P. giganteus* (Cunn. ex Moq.) R.W.Davis & R.Butcher.

Ptilotus polystachyus is a widely distributed taxon found in all mainland States and the Northern Territory. Benl (1983) recognised four varieties: var. *polystachyus*, var. *arthrotrichus* Benl, var. *longistachyus* (W.Fitzg.) Benl and var. *pullenii* (Benl) Benl. Within var. *polystachyus* and var. *arthrotrichus* he distinguished four formae: f. *polystachyus* and f. *rubriflorus* (J.M.Black) Benl, and f. *arthrotrichus* Benl and f. *ruber* Benl, respectively.

Ptilotus longistachyus W.Fitzg. was demoted to a variety of *P. polystachyus* by Benl (1960) after he examined specimens (see Benl 1983: 271; none held at PERTH) that he regarded as intermediate between the species. *Ptilotus pullenii* Benl was demoted to a variety of *P. polystachyus* by Benl (1983) after he determined that the floral morphology of *P. pullenii* was very similar to that of var. *longistachyus*. Although he noted that var. *arthrotrichus* was more closely related to var. *polystachyus* than were var. *longistachyus* and var. *pullenii*, Benl (1983: 274) asserted that the latter two taxa could not be recognised at a higher taxonomic rank, citing a collection of each that he felt was intermediate with var. *polystachyus* in floral characters.

In his synopsis of *Ptilotus* in eastern Australia, Bean (2008: 245) stated that '[m]ost if not all of these varieties and formae are of no taxonomic consequence' and synonymised var. *arthrotrichus*, f. *arthrotrichus*, f. *rubriflorum* and f. *ruber* under a broadly circumscribed *P. polystachyus*. Regarding var. *longistachyus* and var. *pullenii*, Bean (2008) noted that the former may be worthy of its varietal rank due to its short tepals, but did not mention the latter. The Western Australian Herbarium (PERTH) has maintained all four varieties of *P. polystachyus* on the *Census of Western Australian Plants* (see Western Australian Herbarium 1998–) pending the completion of taxonomic studies on the western taxa of *Ptilotus*.

In support of Bean (2008), it is evident from examination of all PERTH specimens of *P. polystachyus* that var. *polystachyus* and var. *arthrotrichus* are very similar in overall morphology and these taxa share an oblique staminal cup bearing stiff short hairs, and a gibbous ovary (Figure 4A in Benl 1983). Comparatively, var. *longistachyus* and var. *pullenii* clearly differ from these in having a (sub-) symmetrical staminal cup bearing long, silky hairs, and a non-gibbous ovary (Figure 4B in Benl 1983). As substantially more collections of all these varieties are available for study now than were available to Benl, it is possible to critically re-examine the boundaries between the taxa as well as the characters used for their distinction. To this end a morphometric analysis of *P. polystachyus sens. lat.* has been undertaken.

Methods

Nine characters (four continuous quantitative characters and five qualitative binary/multistate characters; Table 1) were measured for 34 specimens of *Ptilotus polystachyus* held at PERTH and on loan from CANB. These comprised 16 specimens of var. *polystachyus*, 12 specimens of var. *arthrotrichus* (including the holotype, *C.A. Gardner* 6323), six specimens of var. *longistachyus* (including a syntype, *W.V. Fitzgerald* 1080), two specimens of var. *pullenii* (including the holotype, *Hj. Eichler* 22488) and two specimens identified only as *P. polystachyus* but having the morphology of var. *longistachyus* and var. *pullenii*. Specimens of var. *polystachyus* were selected to encompass the geographic range of this species across Western Australia and the range of morphological variation observed.

Five measurements were made for each character with the mean used in morphometric analysis. Indumentum of the ovary and style was assessed using a dissecting microscope and subjectively coded to reflect the variation observed. Some characters used by Benl (1983) to distinguish between the varieties were not used in the analysis as they were found to vary continuously across all specimens and could not be scored as discrete characters. These included leaf shape, spike width, apex shape and colour at maturity, indumentum of the vegetative parts, and bract shape and indumentum. Characters found by the first author to be reliable for discriminating taxa within *Ptilotus* (i.e. tepal, bract, bracteole and style length) supplemented the data set; however, style length was excluded from the analysis as it was strongly correlated to tepal length. A character not previously recorded for *P. polystachyus sens. lat.* and included in the analysis concerns the morphology of the pedicel and its apex (Table 1). All characters were measured from herbarium specimens.

Where available, specimens cited by Benl (1983) as displaying intermediate morphology between varieties (e.g. *A.C. Beaglehole* 54017, var. *longistachyus* tending towards var. *polystachyus*) or as clearly illustrating the discriminating characters between varieties (e.g. *A.S. George* 12813, var. *longistachyus*; *D. Symon* 5271, var. *pullenii*) were included in the data set. Voucher specimen details are presented in Table 2.

Table 1. Characters used in the morphometric analysis of *Ptilotus polystachyus* and character codes used in the NMDS ordination.

Quantitative characters	Code
1. Bract length (mm):	BL
2. Bracteole length (mm):	BrL
3. Tepal length (mm):	TL
4. Pedicel length (mm):	PL
Qualitative characters	
1. Ovary summit indumentum: 1 – glabrous, 2 – sparsely hairy, 3 – densely hairy	IOS
2. Style base indumentum: 0 – glabrous, 1 – hairy	ISB
3. Ovary shape: 0 – gibbous, 1 – not gibbous	OS
4. Staminal cup shape: 0 – oblique, 1 – sub-symmetrical or symmetrical	SCS
5. Pedicel morphology: 0 – slender, apical disc reduced, 1 – squat, apical disc prominent	PM

The resulting data matrix was analysed phenetically using the software package Primer 6 (v. 6.1.13) (Clarke & Gorley 2006). The Gower metric (Gower 1971) was used to create a resemblance matrix, as it is suitable for use with datasets containing a mixture of qualitative and quantitative characters (Crisp & Weston 1993; Flann *et al.* 2008). The unweighted pair-group method of arithmetic averages (UPGMA) was used to create a dendrogram of hierarchically clustered individuals from this association matrix. This matrix was also used to derive an ordination using non-metric multidimensional scaling (NMDS). The ordination was run 100 times using random starting configurations and the result having the lowest Kruskal stress value in two- and three-dimensional space retrieved. Spearman rank correlation coefficients were calculated to assess the relative contribution of each character to the ordination.

Results

Cluster analysis of the *Ptilotus polystachyus* dataset identified two main groups: the first consisted of the individuals of var. *longistachyus*, var. *pullenii* and var. *indet* united at a similarity level of *c.* 90, while the second contained all of the individuals of var. *polystachyus* and var. *arthrotrichus* united at a similarity level of *c.* 75. These two groups were united at a similarity level of *c.* 40 (Figure 1).

This clear division of the samples into two groups was also dramatically recovered in the two- and three-dimensional NMDS ordinations (Figure 2A; three-dimensional ordination not shown), where the samples of vars *longistachyus+pullenii+indet* and vars *polystachyus+arthrotrichus* formed two tight clusters distantly separated from one another, due to the inclusion in the dataset of three qualitative characters (ovary shape, staminal cup shape, pedicel morphology) that were perfect discriminators between the pairs of varieties. Magnifying the ordination space around each cluster shows that the samples of var. *longistachyus* and var. *pullenii* (Figure 2B) and of var. *polystachyus* and var. *arthrotrichus* (Figure 2C) cannot be clearly separated from one another. Kruskal stress values for the two- and three-dimensional ordinations were equally extremely low (0.01). Characters contributing

Table 2. Voucher specimens used in the morphometric analysis of *Ptilotus polystachyus sens. lat.* indicating the variety each specimen was identified as at the time of analysis and the species to which it is now assigned. CANB/CBG and PERTH sheet numbers were used to label the specimens in the analysis. Specimens marked with an asterisk (*) are types.

Variety	Species	Collector	Locality	Voucher
<i>arthrorrichus</i>	<i>polystachyus</i>	A.C. Beauglehole 59267 & E.G. Errey 2972	67 km NE of Lagrange Aboriginal Mission turnoff, Great Northern Hwy	PERTH 00340170
<i>arthrorrichus</i>	<i>polystachyus</i>	E.M. Bennett 1932	19 miles W of Langly [Langely] Bridge, Fitzroy [Crossing]	PERTH 00226734
<i>arthrorrichus</i>	<i>polystachyus</i>	N.T. Burbidge 1291	Nalgi Station, 80 Mile Beach	PERTH 00337137
<i>arthrorrichus</i>	<i>polystachyus</i>	G.W. Carr 3539 & A.C. Beauglehole 47317	E branch of Wolfe Creek, c. 60 km S of Halls Creek, Kimberley	PERTH 00337153
<i>arthrorrichus</i>	<i>polystachyus</i>	B.J. Carter 26	One Arm Point, SE tip of Dampierland	PERTH 00814318
<i>arthrorrichus</i>	<i>polystachyus</i>	C.A. Gardner 6323	N of Roebourne	* PERTH 00227633
<i>arthrorrichus</i>	<i>polystachyus</i>	K.F. Kenneally 5510	Transect through to Geegully Creek, Edgar Range, SE of Broome	PERTH 227625
<i>arthrorrichus</i>	<i>polystachyus</i>	K.F. Kenneally 5579	Edge of transect NE towards Edgar Range from D2, Edgar Range, SE Broome	PERTH 222895
<i>arthrorrichus</i>	<i>polystachyus</i>	N.F. Norris 880	31 km SW Sandfire Flat along Great Northern Hwy	PERTH 00302503, MEL
<i>arthrorrichus</i>	<i>polystachyus</i>	Y. Power 740	Camballin	PERTH 00226645
<i>arthrorrichus</i>	<i>polystachyus</i>	R. Pullen 9323	c. 80 km towards Borrolooka from Daly Waters	CANB 0263458
<i>arthrorrichus</i>	<i>polystachyus</i>	R.D. Royce 1878	E of Gregory Range along Number 1 Rabbit Proof Fence	PERTH 00227641
indet	<i>giganteus</i>	I. Cowie 4578 & J. Egan	Mataranka, Eisey National Park	CANB 0472924, DNA, M
indet	<i>giganteus</i>	I.R. Telford 7642 & J.W. Wrigley	Kakadu National Park, Obiri Rock track, 4 km NW of Alligator River crossing of OenPELLI Rd	CGB 8003022
<i>longistachyus</i>	<i>giganteus</i>	A.C. Beauglehole 54017	The Grotto, 2 km W of Great Northern Hwy, c. 30 km SSE Wyndham	PERTH 00227684, CANB
<i>longistachyus</i>	<i>giganteus</i>	W.V. Fitzgerald 1080	Between Station Ck and Isdell River	* PERTH 01558242
<i>longistachyus</i>	<i>giganteus</i>	A.S. George 12813	Near Gariyeli Ck, Prince Regent River Reserve	PERTH 227706, AD, CANB, K, MEL

<i>longistachyus</i>	<i>giganteus</i>	<i>K.F. Kenneally</i> 10119	Crocodile Creek, Yampi Peninsula, W Kimberley	PERTH 02279363
<i>longistachyus</i>	<i>giganteus</i>	<i>K.F. Kenneally</i> 11251	Above King George Falls, King George River, NE Kimberley	PERTH 02250128
<i>longistachyus</i>	<i>giganteus</i>	<i>P.G. Wilson</i> 11146	Osborne Island, Bonaparte Archipelago	PERTH 227714
<i>polystachyus</i>	<i>polystachyus</i>	<i>P.G. Armstrong</i> s.n.	900 m NW of the intersection of Mulga Rd West and Gordon Rd, Stakehill	PERTH 05944899
<i>polystachyus</i>	<i>polystachyus</i>	<i>K.J. Atkins</i> 461	Paraburdoo Mine flats	PERTH 06108172
<i>polystachyus</i>	<i>polystachyus</i>	<i>R.J. Cranfield</i> 415	Coogee, opposite South Fremantle Power Station	PERTH 00222887
<i>polystachyus</i>	<i>polystachyus</i>	<i>H.N. Foote</i> 14	East Road to Cooma Well	PERTH 02465396
<i>polystachyus</i>	<i>polystachyus</i>	<i>D.W. Goodall</i> 3065	Belele Station, (area 58) Danthroobubba paddock	PERTH 06293964
<i>polystachyus</i>	<i>polystachyus</i>	<i>W. Greuter</i> 22562	Shark Bay, 2 km E of Monkey Mia along road to Denham	PERTH 03152472
<i>polystachyus</i>	<i>polystachyus</i>	<i>S.D. Hopper</i> 2847	Gibson Desert, NE end of Clutterbuck Hills	PERTH 00785873
<i>polystachyus</i>	<i>polystachyus</i>	<i>A.E. de Jong</i> s.n.	Gary Hwy [Gibson Desert]	PERTH 06633366
<i>polystachyus</i>	<i>polystachyus</i>	<i>R. Meissner & B. Bayliss</i> 1412	Robinson Range, c. 3.35 km E of spot elevation 587m and c. 2.5 km N Mt Fraser	PERTH 07735669
<i>polystachyus</i>	<i>polystachyus</i>	<i>S. Murray</i> 292	Kulin area	PERTH 05282845, CANB
<i>polystachyus</i>	<i>polystachyus</i>	<i>R. Pickering</i> Y 42	c. 30 m NE of Pioneer Drive opposite house number 25; Yangebup	PERTH 07105029
<i>polystachyus</i>	<i>polystachyus</i>	<i>M.O. Rankin</i> 1300	80 km W of Stuart Hwy on Buchanan Hwy	CBG 7911244, DNA, K
<i>polystachyus</i>	<i>polystachyus</i>	<i>L.W. Sage</i> 1034	2.25 km S on Pipeline track off Wellard Rd, Leda Nature Reserve	PERTH 05005035
<i>polystachyus</i>	<i>polystachyus</i>	<i>J.F. Smith</i> 221	On edge of car park at Kalbarri shopping centre	PERTH 06593003
<i>polystachyus</i>	<i>polystachyus</i>	<i>G.M. Storr</i> s.n.	Cunderdin	PERTH 00842230
<i>polystachyus</i>	<i>polystachyus</i>	<i>L.S.J. Sweedman</i> 6736	7.7 km S of the Onslow and Old Onslow Rds turnoff	PERTH 07379439
<i>pullenii</i>	<i>giganteus</i>	<i>Hj. Eichler</i> 22488	Hidden Valley, just N of Kununurra	* CANB 267398
<i>pullenii</i>	<i>giganteus</i>	<i>D.E. Symon</i> 5271	3 miles S of Ord River Crossing, 64 miles N of Halls Creek	PERTH 00226688, ADW, M

most to the separation between vars *longistachyus*+*pullenii*+indet and vars *polystachyus*+*arthrotrichus* (Figure 2A; Table 3) are ovary summit indumentum ($R = -0.7828$), pedicel morphology ($R = 0.7629$), staminal cup shape ($R = -0.7629$) and ovary shape ($R = -0.7629$), while those contributing most to the spread of samples within each group are tepal length ($R = 0.7863$), bract length ($R = 0.7645$) and bracteole length ($R = 0.7515$).

Discussion

The morphometric analysis suggests that two distinct species should be recognised in *Ptilotus polystachyus sens. lat.* rather than the four varieties recognised by Benl (1983). The analysis also supports the synonymy of var. *arthrotrichus* under var. *polystachyus* proposed by Bean (2008) and indicates that var. *longistachyus* and var. *pullenii* should be synonymised at a higher taxonomic rank.

As previously stated, many of the characters used by Benl (1983) to distinguish the varieties vary continuously among all specimens and cannot be used to accurately identify them. For example, Benl (1983: 271) regarded var. *longistachyus* and var. *pullenii* as differing primarily in the colour of the tepal tips, as well as in the diameter of the spikes, the shape of the spike apex, and in the form, hairiness and midrib of the bracts, and cited *A.S. George* 12813 (var. *longistachyus*, PERTH 0227706) and *D.E. Symon* 5271 (var. *pullenii*, PERTH 00226688) as being specimens which clearly showed these differences. Re-examination of these specimens could not discern any significant differences between them in these critical characters, with the diameter and shape of the spike related to their age

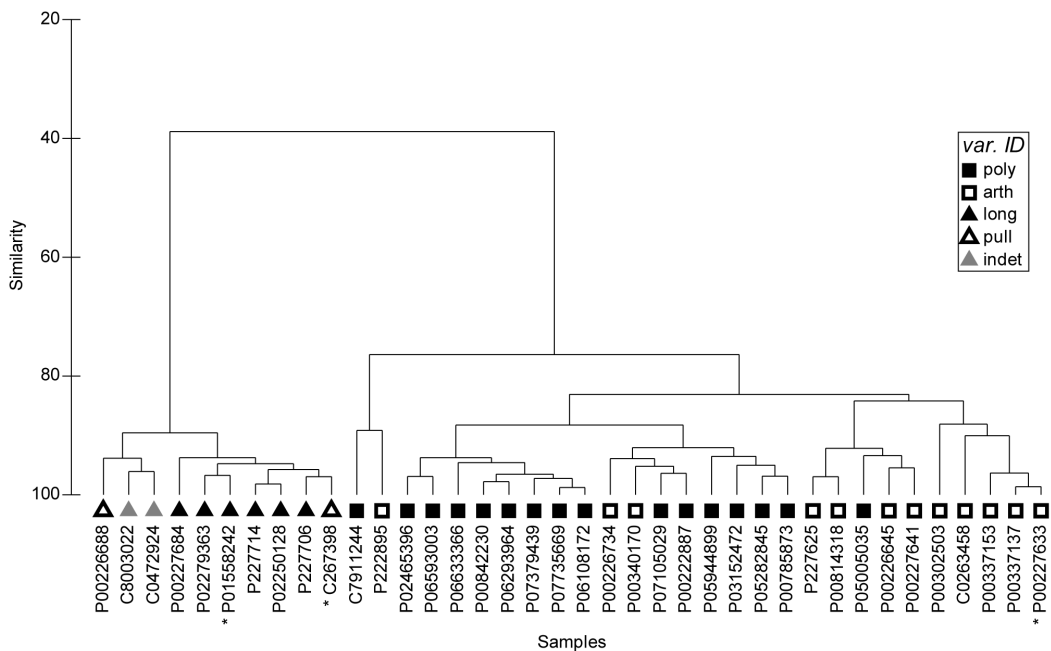


Figure 1. UPGMA dendrogram of the four varieties of *Ptilotus polystachyus* based on 34 specimens by nine characters, using the Gower metric. Specimens labelled by their PERTH (P) and CANB/CBG (C) sheet numbers. Specimens marked with an asterisk (*) are types.

and the bract characters found to vary between spikes on each specimen. The inconsistency of spike colour for taxon identification in *P. polystachyus sens. lat.* has already been noted by Bean (2008: 245). Cluster analysis found that *A.S. George* 12813 was most similar to the type of var. *pullenii* than to other specimens of var. *longistachyus* (Figure 1) and a close association between *A.S. George* 12813 and *D.E. Symon* 5271 was also recovered in the ordination (Figure 2B). Type specimens of each of these varieties were also closely associated (Figure 2B), in the middle of the spread of samples. Based on this morphometric analysis it is evident these two varieties should be synonymised.

Similarly, Benl (1983: 274) cited *A.C. Beauglehole* 54017 (PERTH 00227684) as having (unspecified) morphology intermediate between var. *longistachyus* and var. *polystachyus*, and used this assertion

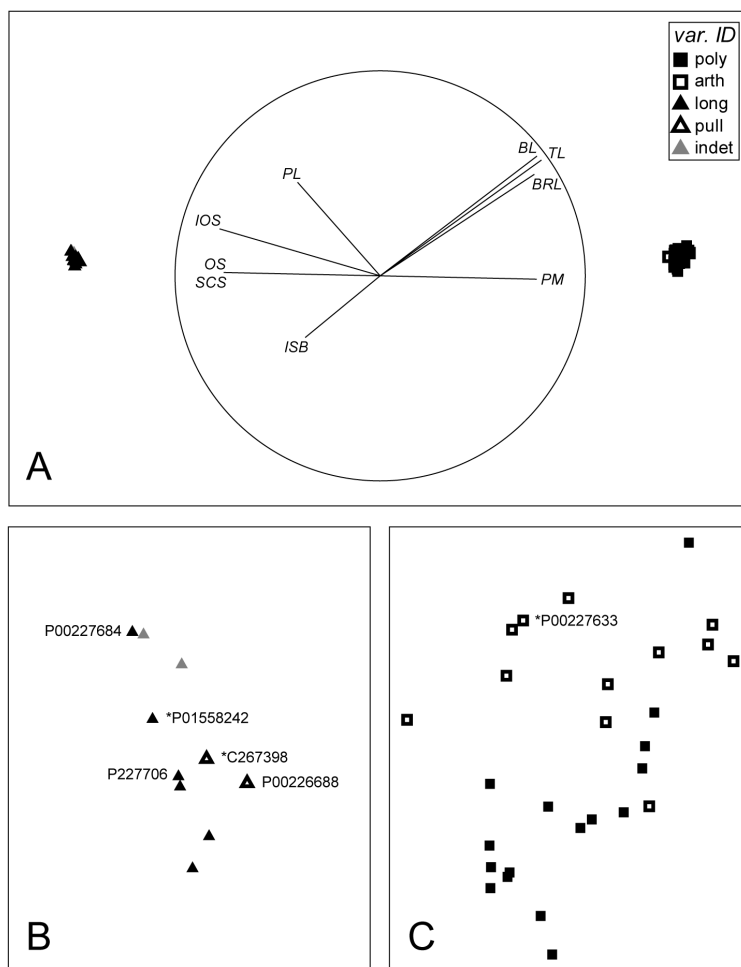


Figure 2. Two-dimensional NMDS ordination of the four varieties of *Ptilotus polystachyus* based on 34 specimens by nine characters, using the Gower metric. The direction of contribution of each character to the ordination, calculated by the Spearman rank correlation coefficient, is illustrated in the circular inset. Character codes as for Table 1. A – ordination space showing the distant separation of vars *longistachyus+pullenii+indet* from vars *polystachyus+arthrotrichus*; B – magnified ordination of vars *longistachyus+pullenii+indet* showing the positions of the types of var. *longistachyus* and var. *pullenii* and of specific samples cited by Benl (1983) (see text for discussion); C – magnified ordination of vars *polystachyus+arthrotrichus* showing the position of the type of var. *arthrotrichus*. Specimens marked with an asterisk (*) are types. Refer to Table 2 for specimen information.

Table 3. Spearman rank (R) correlation coefficients between the characters used to create the NMDS ordination and the ordination axes. Character codes as for Table 1.

	BL	BRL	TL	PL	IOS	ISB	OS	SCS	PM
MDS 1	0.7645	0.7515	0.7863	-0.4027	-0.7828	-0.3654	-0.7629	-0.7629	0.7629
MDS 2	0.5839	0.4949	0.5645	0.4563	0.2291	-0.3009	0.0163	0.0163	-0.0163

to retain var. *longistachyus* at varietal rank. Both cluster analysis (Figure 1) and the ordination (Figure 2B) show that this specimen clearly groups with other samples of var. *longistachyus*, and with vars *pullenii*+indet, and that vars *longistachyus*+*pullenii*+indet are distantly separated from vars *polystachyus*+*arthrotrichus* (Figure 2A).

In contrast, characters used in Benl's (1983: 273) key to separate vars *longistachyus*+*pullenii* from vars *polystachyus*+*arthrotrichus* (shape of the staminal cup and the ovary, and indumentum of the ovary summit) were found to have high Spearman rank correlation coefficients (Table 2) and were extremely reliable for separating these pairs of varieties. Pedicel morphology was not discussed by Benl (1960, 1979, 1983) but has been found here to be a perfect discriminator between vars *polystachyus*+*arthrotrichus* and vars *longistachyus*+*pullenii*. After flowers have been shed, it can be seen that vars *polystachyus*+*arthrotrichus* have squat pedicels (almost as broad as long) with a prominent disc at the apex, and that the bracts and bracteoles are closely aligned to each other. In vars *longistachyus*+*pullenii* the pedicels are slender (length to width ratio 7:1) with a greatly reduced disc at the apex, and the bracts and bracteoles are widely separated (Figure 3).



Figure 3. Comparative pedicel (p) and disc (d) morphology of *Ptilotus polystachyus sens. lat.* A – vars *polystachyus*+*arthrotrichus* (var. *arthrotrichus*, G. Byrne 1245), showing the prominent, robust disc at the apex of the squat pedicel; B – vars *longistachyus*+*pullenii* (var. *longistachyus*, A.A. Mitchell 8458), showing the small, disintegrating disc at the apex of the slender pedicel. The pedicel in profile at lower left has had the disc fall away completely.

Separation of samples among vars *polystachyus*+*arthrotrichus* is related to the length of tepals, bracts, bracteoles and pedicels, with most of the specimens identified prior to analysis as var. *arthrotrichus* having flowers at the larger end of the size range. Measurement values overlap between specimens of these varieties, however, as well as between vars *polystachyus*+*arthrotrichus* and vars *longistachyus*+*pullenii* (Table 4), and are not reliable for distinguishing taxa.

Table 4. Morphological comparison of *Ptilotus polystachyus* and *P. giganteus*.

Characters	<i>Ptilotus polystachyus</i>	<i>Ptilotus giganteus</i>
Bract length (mm)	3–7.1	2.2–3.8
Bracteole length (mm)	3.3–5.6	2.9–4.4
Tepal length (mm)	9–17	7.5–11.8
Staminal cup shape	Oblique	(Sub-) symmetrical
Staminal cup indumentum	Sparse short hairs	Copious long silky hairs
Ovary shape	Gibbous	Not gibbous
Ovary summit	Sparsely hairy or glabrous	Densely hairy
Style base	Sparsely hairy	Densely hairy
Style length (mm)	7–13.3	4.5–10.5
Pedicel after abscission	Squat, with prominent disc at apex	Slender, with reduced disc at apex

Based on the two clear groups recovered by the classification and ordination we recognise here two taxa, distinguishable from one another by a suite of qualitative characters (Table 4). As proposed by Bean (2008), *P. polystachyus* is accepted here as being a widespread and variable species that it would be meaningless to subdivide. Similarly, Benl's (1983) var. *longistachyus* and var. *pullenii* should not be recognised as distinct entities but combined into a single taxon and recognised at species rank. The earliest available name for vars *longistachyus*+*pullenii* at species rank is *Trichinium giganteum* Cunn. ex Moq. (Moquin-Tandon 1849). Accordingly, the new combination *P. giganteus* (Cunn. ex Moq.) R.W.Davis & R.Butcher is made here.

Taxonomy

Ptilotus polystachyus (Gaudich.) F.Muell., *Fragm.* 6: 230 (1868). *Trichinium polystachyum* Gaudich. in Frec., *Voy. Uranie Bot.* 445 (1829); *Ptilotus polystachyus* var. *polystachyus*, *Mitt. Bot. Staatssaml. München* 7: 317 (1970); *Ptilotus polystachyus* f. *polystachyus*, *Nuytsia* 4: 273 (1983). *Type*: Shark Bay, Western Australia, s. dat. [September 1818], C. Gaudichaud-Beaupre, s.n. (*syn*: BM n.v., G n.v., P n.v., *fide* Benl (1983)).

Trichinium alopecuroideum Lindl. in T.Mitch., *Three Exped. Australia* 2: 12 (1838); *Ptilotus alopecuroideus* (Lindl.) F.Muell., *Fragm.* 6: 227 (1868); *Trichinium alopecuroideum* Lindl. var. *alopecuroideum*, *Trans & Proc. Roy. Soc. South Australia* 40: 61 (1916); *Ptilotus alopecuroideus* (Lindl.) F.Muell. f. *alopecuroideus*, *Mitt. Bot. Sataatssamml. München* 2: 402 (1958). *Type*: interior of New Holland [Byrnes Ck, New South Wales], 24 March 1836, T.L. Mitchell s.n. (*holo*: CGE n.v., digital image at BRI, *fide* Bean (2008); *iso*: BM n.v., K n.v., MEL n.v., *fide* Bean (2008)).

Trichinium concicum Lindl. in T.Mitch., *J. Exped. Trop. Australia* 363 (1848), *nom. illeg., non* Spreng. (1824).

Trichinium alopecuroideum var. *rubriflorum* J.M.Black, *Trans. & Proc. Roy. Soc. South Australia* 40: 61 (1916); *Ptilotus alopecuroideus* f. *rubriflorus* (J.M.Black) Benl, *Mitt. Bot. Staatssamml. München* 3: 518 (1960). *Type*: near Oodnadatta, South Australia, November 1914, *Staer s.n. (holo: AD n.v., fide* Bean (2008)).

Ptilotus polystachyus var. *arthrotrichus* Benl, *Mitt. Bot. Staatssamml. München* 7: 317 (1970); *Ptilotus polystachyus* f. *arthrotrichus* (Benl) Benl, *Nuytsia* 4: 273 (1983). *Type*: 6 miles [10 km] north of Roeburn, Western Australia, 17 October 1941, *C.A. Gardner* 6323 (*holo: PERTH!*; *iso: PERTH!*).

Ptilotus polystachyus f. *ruber* Benl, *Mitt. Bot. Staatssamml. München* 15: 169 (1979). *Type*: 28 km north-east of Shay Gap, Western Australia, 22 July 1977, *I.R. Telford* 59785 (*holo: CANB n.v., fide* Bean (2008)).

Erect, *annual* or short-lived *perennial herbs*, to 1 m high. *Stems* ribbed, sparsely to densely hairy with crisped, nodose or verticillate hairs. *Cauline leaves* alternate, oblanceolate, 10–80 mm long, 3–12 mm wide, sparsely or densely hairy with crisped, nodose or verticillate hairs, margins undulate. *Inflorescences* terminal, green, sometimes fading red, cylindrical, 20–210 mm long, 18–34 mm wide; *bracts* ovate to narrowly ovate, translucent or slightly straw coloured toward mid rib, 3.1–7.1 mm long, sparsely hairy with verticillate hairs, glabrescent; *bracteoles* broadly ovate, translucent, 3–5.6 mm long, glabrous or with scattered hairs. *Flowers* pedicellate; *pedicels* squat, 0.2–1.3 mm long with prominent disc at apex; *outer tepals* green, linear, concave, 9–17 mm long, densely hairy at base becoming sparse towards apex with long, silky, nodose hairs to 4 mm long, apex entire, rounded, slightly hooded, glabrous; *inner tepals* 9–17 mm long; *staminal cup* oblique, 0.9–1.5 mm long, glabrous; *stamens* 4; *staminodes* 1; *style* sigmoid, centrally fixed to ovary, 7–14 mm long, glabrous or sparsely hairy towards base; *ovary* obovoid, gibbous, glabrous or sparsely hairy. *Seed* slightly dull, brown, to 2.3 mm long.

Distribution and habitat. Current herbarium collections show that *P. polystachyus* occurs in all mainland States and the Northern Territory of Australia, however the species is absent from the tropical north. The distribution of this species abuts that of *P. giganteus* near Cape Leveque in northern Western Australia. *P. polystachyus* occurs on a wide range of soils in a variety of habitats and is commonly regarded as a disturbance opportunist, often dominating roadside verges.

Ptilotus giganteus (Cunn. ex Moq.) R.W.Davis & R.Butcher, *comb. nov.*

Trichinium giganteum Cunn. ex Moq. in A.P. de Candolle, *Prodr.* 13(2): 296 (1849). *Type*: Montague Sound, north west coast [Western Australia], 1820, *A. Cunningham* 201 (*holo: G-DC n.v.; iso: BM n.v., CGE n.v., K n.v., MEL n.v., NSW n.v., P n.v., fide* Bean (2008)).

Ptilotus longistachyus W.Fitzg., *J. Proc. Roy. Soc. W. Australia* 3: 138 (1918); *Trichinium longistachyum* (W.Fitzg.) C.A. Gardner, *Enum. Pl. Austral. Occid.* 40 (1930); *Ptilotus polystachyus* var. *longistachyus* (W.Fitzg.) Benl, *Mitt. Bot. Staatssamml. München*, 3: 518 (1960). *Type*: between Station Creek and Isdell River, Western Australia, June 1905, *W.V. Fitzgerald* 1080 (*holo: PERTH!* (photo M); *iso: E n.v., NSW n.v., fide* Bean (2008)).

Ptilotus pullenii Benl, *Mitt. Bot. Staatssamml. München* 15: 169 (1979); *Ptilotus polystachyus* (Gaudich.) F.Muell. var. *pullenii* (Benl) Benl, *Nuytsia* 4: 271 (1983). *Type*: Hidden Valley, just north of Kununurra, Western Australia, 15° 47' S, 128° 45' E, 25 April 1977, H. Eichler 22488 (*holo*: CANB!).

Erect, *annual herbs*, to 1 m high. *Stems* ribbed, sparsely hairy with nodose hairs. *Cauline leaves* alternate, oblanceolate, 10–80 mm long, 3–12 mm wide, sparsely hairy with crisped, nodose hairs, margins undulate. *Inflorescences* terminal, green, sometimes fading red, cylindrical, 20–180 mm long, 20–27 mm wide; *bracts* narrowly ovate, straw coloured becoming translucent toward margins, 2–3.8 mm long, sparsely hairy with crisped, nodose hairs; *bracteoles* broadly ovate, translucent, 2.8–4.4 mm long, glabrous. *Flowers* pedicellate; *pedicels* slender, 0.7–1.6 mm long with reduced disc at apex; *outer tepals* green, linear, concave, 7.5–11.8 mm long, densely hairy at base becoming sparse towards apex with long, silky, nodose hairs to 4 mm long, apex entire, rounded, slightly hooded, glabrous; *inner tepals* 7.5–11.8 mm long; *staminal cup* sub-symmetrical, to 0.5 mm long, glabrous; *stamens* 4; *staminodes* 1; *style* sigmoid, centrally fixed to ovary, 4.5–10.5 mm long, densely hairy towards apex; *ovary* obovoid, densely hairy. *Seed* slightly dull, brown, to 1.8 mm long.

Distribution and habitat. *Ptilotus giganteus* is found in the Northern Botanical Province of Western Australia, extending across the Northern Territory border into Kakadu National Park. Within Western Australia the species occurs roughly from Cape Leveque, north-north-west of Derby in the Dampierland IBRA region, across the North Kimberley through the Ord-Victoria Plains and Victoria Bonaparte IBRA regions, with some collections from the Central Kimberley IBRA region. *P. giganteus* appears restricted to sandstone hills and plateaus.

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