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Revision of generic concepts in Schoeneae subtribe Tricostulariinae (Cyperaceae) with a new Australian genus *Ammothryon* and new species of *Tricostularia*

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Abstract

The *Tricostularia* Nees ex Lehm. group of genera is reviewed and formally recognised as Cyperaceae tribe Schoeneae subtribe Tricostulariinae R.L.Barrett, K.L.Wilson & J.J.Bruhl. Molecular data from plastid *rbc*L and *trnL–F* and nuclear ITS and ETS regions are combined with a novel assessment of morphological characters to support our new classification. Six genera are included: a new genus, *Ammothryon* R.L.Barrett, K.L.Wilson & J.J.Bruhl, and the named genera *Chaetospora* R.Br., *Morelotia* Gaudich., *Tetraria* P.Beauv., *Tricostularia*, and *Xyroschoenus* Larridon. *Ammothryon*, *Chaetospora* and *Tricostularia* are all endemic to southern Australia. *Morelotia* has one species each in Hawaii, French Polynesia and New Zealand, and three species in south-west Western Australia. *Tetraria* has a disjunct distribution in Southern Africa, Borneo, New Guinea and New Caledonia. *Xyroschoenus* is endemic to the Seychelles. *Tetrariopsis* C.B.Clarke (based on *Tetrariopsis octandra* (Nees) C.B.Clarke) is included under an expanded concept of *Morelotia*, which also includes *Tetraria australiensis* C.B.Clarke and *Tetraria microcarpa* S.T.Blake from south-west Western Australia. *Tricostularia bennettiana* R.L.Barrett & K.L.Wilson, *Tricostularia davisii* R.L.Barrett & K.L.Wilson, *Tricostularia lepschii* R.L.Barrett & K.L.Wilson, *Tricostularia newbeyi* R.L.Barrett & K.L.Wilson, and *Tricostularia sandifordiana* R.L.Barrett & K.L.Wilson are described as new species from south-west Western Australia. The following new combinations are made: *Ammothryon grandiflorum* (Nees ex Lehm.) R.L.Barrett, K.L.Wilson & J.J.Bruhl, *Morelotia australiensis* (C.B.Clarke) R.L.Barrett & K.L.Wilson, *Morelotia microcarpa* (S.T.Blake) R.L.Barrett & K.L.Wilson, *Morelotia octandra* (Nees) R.L.Barrett & J.J.Bruhl and *Tricostularia drummondii* (Steud.) R.L.Barrett & K.L.Wilson. *Tricostularia drummondii* is reinstated from synonymy (formerly *Discopodium drummondii* Steud.), having previously been confused with *T. exsul* (C.B.Clarke) K.L.Wilson & R.L.Barrett. Lectotypes are selected for *Chaetospora flexuosa* var. *gracilis* Boeckeler, *Discopodium drummondii* Steud., *Elynanthus grandiflorus* Nees ex Lehm., *Lampocarya affinis* Brongn., *Lepidosperma exsul* C.B.Clarke, *Morelotia gahniiformis* Gaudich. var. *minor* A.Rich., *Tetraria australiensis* C.B.Clarke, *Tetraria capillacea* var. *intercedens* Kük., *Tricostularia compressa* Nees ex Lehm. and *Tricostularia neesii* Lehm.

Keywords: *Chaetospora*; *Costularia*; *Gahnia*; *Lophoschoenus*; *Machaerina*; *Morelotia*; *Schoenus*; *Tetraria*; *Tetrariopsis*; *Xyroschoenus*; Plant systematics; Taxonomy; Morphology; Sedge; Australia; Borneo; French Polynesia; Hawaii; New Caledonia; New Guinea; New Zealand; Seychelles; Southern Africa.

Introduction

Cyperaceae tribe Schoeneae has been characterised by very high levels of morphological variability, combined with high species diversity (over 600 species; Govaerts *et al.* 2020; R.L. Barrett *et al.* unpubl. data). Circumscription of many genera has remained problematic in morphological classifications, and the relationships between genera have been very uncertain (Bruhl 1995; Goetghebeur 1986, 1998). The widespread uptake of molecular sequencing methods has provided many new, and sometimes unexpected, insights into relationships within Schoeneae (Zhang *et al.* 2004, 2007; Slingsby and Verboom 2006; Verboom 2006; Bruhl *et al.* 2008a, 2008b; Simpson *et al.* 2008; Barrett 2012; Viljoen *et al.* 2013; Muasya 2016; Musili *et al.* 2016; Barrett *et al.* 2017, 2019, 2020, 2021a, 2021b; Semmouri *et al.* 2019). Many genera have been revealed to be paraphyletic, requiring considerable re-circumscription across the tribe (Wilson *et al.* 2012; Elliott and Muasya 2017, 2018, 2019; Larridon *et. al.* 2018a, 2018b, 2019; Elliott *et al.* 2019; Barrett *et al.* 2019, 2020). Increased sampling in phylogenies, and targeted sequencing of 100s of loci is now providing resolution for many previously poorly resolved relationships within Cyperaceae (Larridon *et al.* 2020, 2021a, 2021b; Villaverde *et al.* 2020; Costa *et al.* 2021).

The conclusions reached here are the combination of considerable time studying herbarium material around the world, extensive literature searches, and extensive fieldwork, supported by molecular phylogenetic data. Many Schoeneae genera, as traditionally circumscribed, have species that are now placed in quite distantly related groups within the tribe, so reference to past synonyms can be an ongoing source of confusion for understanding relationships. We here propose that recognition of subtribes will assist in defining the most significant relationships within Schoeneae, and provide a basis for careful re-examination of morphological diversity and homology across the tribe. Most subtribe names will be validated in a forthcoming paper providing a new global classification of Cyperaceae, to which this paper is a precursor (Larridon *et al.* 2021b). Here we define the new subtribe Tricostulariinae R.L.Barrett, K.L.Wilson & J.J.Bruhl with six constituent genera (Table 1): the new genus *Ammothryon* R.L.Barrett, K.L.Wilson & J.J.Bruhl, and the named genera *Chaetospora* R.Br., *Morelotia* Gaudich., *Tetraria* P.Beauv., *Tricostularia* Nees ex Lehm., and *Xyroschoenus* Larridon. The delimitation of each of the genera accepted here has only recently been refined (Larridon *et al.* 2018a, 2018b; Barrett *et al.* 2020) or is newly defined in this paper. The *Tricostularia* clade has a crown node age of around 28.4 (19.8–39.2) Ma (Larridon *et al.* 2018a). Viljoen *et al.* (2013) found that this clade most likely originated in Australia, with the current distribution of genera outside Australia most likely due to long-distance dispersal events. Estimates should be revised now that more molecular data are available and fossils such as *Gahniocarpus* Benl (Benl 1942) should be evaluated to determine whether they can be used to time-calibrate the phylogeny of tribe Schoeneae as there is still a general lack of good fossils for many clades of Cyperaceae (Smith *et al.* 2010).

Table 1. Genera in subtribe Tricostulariinae with number of species, number of sequenced species represented in this paper, estimated crown / node divergence age in millions of years (Ma; from Larridon *et al.* 2018a) and general distribution.

Genus	No. of species	No. sequenced	Divergence age	Distribution
Tricostulariinae	*c.* 66	50 (76%)	58 / 28 Ma	Africa, Asia, Australia, Pacific
Ammothryon	1	1 (100%)	22 / – Ma	South-west Australia
Chaetospora	3	2 (67%)	25 / – Ma	Southern Australia
Morelotia	6	4 (67%)	17 / 5 Ma	South-west Australia, New Zealand, Rapa Iti, Hawaii
Tetraria	*c.* 39	32(+) (82%)	20 / 17 Ma	New Caledonia, Malesia, Southern Africa
Tricostularia	*c.* 16	10 (62%)	25 / – Ma	Southern Australia
Xyroschoenus	1	1 (100%)	17 / – Ma	Seychelles

Within the *Tricostularia* clade, the most significant taxonomic changes over time have been in the genus *Tetraria*, which has been difficult to define prior to detailed phylogenetic studies. *Tetraria* has been considered a primarily southern African genus, though numerous segregates have been recognised even within that region: *Schoenopsis* P.Beauv. ex T.Lestib. (Lestiboudois 1819); *Lepisia* C.Presl (Presl 1829); *Sclerochaetium* Nees (1832); *Aulacorhynchus* Nees (Nees 1834) and *Boeckeleria* T.Durand (Durand 1888). The genus *Lophoschoenus* Stapf was proposed for species from New Caledonia originally described under *Schoenus* L. (Stapf and Turrill 1914). Kükenthal (1939a) reduced *Lophoschoenus* to a subgenus of *Costularia* C.B.Clarke, a position followed by Raynal (1974) when he described several additional species. Taxa in the *Lophoschoenus* clade have recently been incorporated into a modified definition of *Tetraria* (Larridon *et al.* 2018b).

Several miscellaneous species from Australian and Borneo have also been included under *Tetraria*: *T. australiensis* C.B.Clarke (Clarke 1908); *T. octandra* (Nees) Kük. (Kükenthal 1931); *Tetraria capillaris* (F.Muell.) J.M.Black and *T. monocarpa* (J.M.Black) J.M.Black (Black 1934); *T. halmaturina* (J.M.Black) J.M.Black (Black

1943); *T. microcarpa* S.T.Blake (Blake 1949) and *T. borneensis* Kern (Kern 1958). Clarke (1908) established the genus *Tetrariopsis* C.B.Clarke for *Tetraria octandra*, a classification that has been supported by some authors (e.g. Bruhl 1995; Barrett and Pin Tay 2016; Larridon *et al*. 2018a). The morphological distinctions between *Morelotia* and *Tetrariopsis* given by Larridon *et al.* (2018a) break down with the examination of more species. A new classification has just been published for *T. capillaris* and *T. halmaturina*, placing them in a new genus, *Netrostylis* R.L.Barrett, J.J.Bruhl & K.L.Wilson (R.L.Barrett *et al.* 2021a). *Tetraria monocarpa* is generally considered to be a synonym of *Schoenus carsei* Cheeseman (R.L.Barrett *et al.* 2021a). The exact position of *T. borneensis* J.Kern is a matter of ongoing study by R.L. Barrett and I. Larridon after its phylogenetic position was resolved within the *Caustis* clade by Larridon *et al.* (2018a).

While a relatively stable classification of *Tetraria* has been in use in southern Africa for many decades (Levyns 1947; Podlech 1967; Bond and Goldblatt 1984; Forbes 1987; Gordon-Gray 1995; Archer 2000, 2003; Govaerts *et al*. 2007), molecular data revealed that a large clade of these species, including the type species, actually belong to the *Schoenus* L. clade (Slingsby and Verboom 2006; Verboom 2006; Muasya *et al*. 2000, 2009; Viljoen *et al*. 2013; Slingsby *et al*. 2014; Larridon *et al*. 2018a; Semmouri *et al*. 2019). Most species of *Epischoenus* C.B.Clarke (see Levyns 1959) also belong in *Schoenus*, as suggested by Browning and Gordon-Gray (1995) on morphological grounds, but *E. cernuus* Levyns has been shown to belong in *Tetraria* (Verboom 2006; Muasya *et al*. 2009; Viljoen *et al*. 2013; Larridon *et al*. 2018a). The species found to belong in *Schoenus* were transferred there by Elliott and Muasya (2017, 2019) and revised by Elliott and Muasya (2020). As this included the accepted type species of *Tetraria*, to avoid the loss of this iconic genus name from the South African flora, Larridon *et al*. (2017a) have proposed *T. thermalis* (L.) C.B.Clarke as a conserved type, a position followed here pending a formal decision on the proposal by the nomenclature committees.

The concept of the genus *Tricostularia* is here restricted to species occurring in southern Australia, all but one of the species being endemic to the south-west of Western Australia. Following study of the type specimens and analysis of DNA sequence data, *Lepidosperma aphylla* R.Br. and *L. exsul* C.B.Clarke were transferred to *Tricostularia* (Barrett and Wilson 2012). *Tricostularia guillauminii* (Kük.) J.Raynal, *T. paludosa* (R.Br.) Benth. and the widespread *T. undulata* (Thwaites) J.Kern (see Liang *et al.* 2010) have recently been transferred to the new genus *Anthelepis* R.L.Barrett, K.L.Wilson & J.J.Bruhl (Barrett *et al*. 2019). Five named species are currently recognised in *Tricostularia* and five additional phrase-named taxa have been recognised in Western Australia since 2013. Evidence is presented for an expanded number of taxa in the genus, with the recognition of at least four currently unnamed species supported. Detailed morphological examination of specimens suggests around 16 species should be recognised (R.L. Barrett unpubl. data). A full taxonomic revision of the genus is recommended, but further fieldwork is required to assess the taxonomy of a number of anomalous specimens.

Materials and methods

Morphology

Morphological descriptions have been prepared primarily on the basis of material held at NSW, with additional examination of specimens at AD, B, BM, BRI, CANB, CGE, G, HBG, K, L, LD, MEL, NE, NSW, NY, P and PERTH. Images of all specimens available through herbarium online databases listed in Table 2 have been examined and are indicated by * in specimen citations. All specimens cited have been seen unless otherwise indicated as *n.v*. Most of the species treated here have also been examined in the field by at least one of the authors.

Table 2. Online databases where specimen images have been examined for this study.

Database	Website	Date accessed
Auckland War Memorial Museum (AK)	https://www.aucklandmuseum.com/discover/collections-online/search	Sept. 2020
Australasian Virtual Herbarium	https://avh.ala.org.au/	May 2020
Herbarium Berolinense, Berlin Botanic Garden (B)	http://ww2.bgbm.org/Herbarium/default.cfm	May 2020
The Natural History Museum (BM)	https://data.nhm.ac.uk/dataset/collection-specimens	May 2020
Consortium of Pacific Herbaria	https://serv.biokic.asu.edu/pacific/portal/collections/index.php	May 2020
University Halle (HAL)	https://www.botanik.uni-halle.de/herbarium/93690_2831895/	May 2020
JSTOR Global Plants	https://plants.jstor.org	June 2020
Royal Botanic Gardens, Kew (K)	http://apps.kew.org/herbcat/gotoHomePage.do	May 2020
Naturalis (L, U)	http://bioportal.naturalis.nl	June 2020

Database	Website	Date accessed
New York Botanic Garden (NY)	http://sweetgum.nybg.org/science/vh/	May 2020
Muséum National d'Histoire Naturelle (P)	https://science.mnhn.fr/institution/mnhn/collection/p/item/search/form?lang=en_US	June 2020
National Tropical Botanic Garden (NTBG)	https://ntbg.org/database/herbarium/	June 2020
Herbier de la Polynésie française (PAP)	http://nadeaud.ilm.pf/	June 2020
Sweden's Virtual Herbarium	http://herbarium.emg.umu.se/standard_search.html	May 2020
National Museum of Natural History, Smithsonian Institute (US)	https://collections.nmnh.si.edu/search/botany/#new-search	May 2020
Museum of New Zealand, Te Papa Tongarewa (WELT)	https://collections.tepapa.govt.nz/search/	Sept. 2020
Zürich Herbaria (Z, ZSS, ZT)	https://www.herbarien.uzh.ch/en/belegsuche.html	Oct. 2020

DNA extraction

All taxa newly sampled for this study and sequences obtained from GenBank are represented by voucher specimens as detailed in Table 3.

Table 3. Taxa analysed, sequence region, vouchers and GenBank reference numbers. Most vouchers also have duplicates at other herbaria.

Name	Voucher	*rbcL*	*trnL-F*	ITS	ETS
Ammothryon grandiflorum (Nees ex Lehm.) R.L.Barrett, K.L.Wilson & J.J.Bruhl	Western Australia, *Barrett* RLB 3364 (PERTH)	–	KF553525, MW589143	KF553459	KF553576, MW588442
Ammothryon grandiflorum	Western Australia, *Wilson* 8847 (NSW)	–	KF553525	–	–
Chaetospora curvifolia R.Br.	Western Australia, *Barrett* RLB 4174 (PERTH)	–	MW589144	KF553457	–
Chaetospora curvifolia	Western Australia, *Barrett* RLB 5370 (PERTH)	–	MW589145	KX963552	–
Chaetospora curvifolia	Western Australia, *Verboom* 1240 (BOL)	KF553613	KF553523	–	KF553574
Chaetospora turbinata	New South Wales, Australia, *Bruhl* 2355 (NE)	–	MW589146, MW589147	–	–
Chaetospora turbinata	New South Wales, Australia, *McLaughlin & Wilson* 35 (NE)	–	AY230034	–	–
Chaetospora turbinata	Victoria, *Gibbs* 80a (NE)	–	MW589148	KX963551	–
Gahnia deusta (R.Br.) Benth.	S. Australia, *Alcock* 11198 (WS)	U49231	–	–	–
Gahnia deusta	S. Australia, *Barrett* RLB 5140 (PERTH)	–	MW589149	MW605210	MW588443
Gahnia radula (R.Br.) Benth.	Victoria, *Barrett* RLB 5210 (PERTH)	–	MW589150	MW605211	MW588444
Gahnia radula	Victoria, *Walsh & Barrett* NGW 7003 (MEL)	–	–	–	MW588445
Gahnia trifida Labill.	Western Australia, *Barrett & Moody* RLB 4331 (PERTH)	–	MW589151	MW605212	MW588446
Gahnia trifida	Western Australia, *Verboom* 1228 (BOL)	KF553607	KF553509	–	KF553557
Gahnia tristis Nees ex Hook. & Arn.	Japan, *Hirahara* 20361 (OKAY)	AB369963	MF2568	AB261677	–
Gahnia tristis	*Shaw* 885 (K)	–	KF553510	–	KF553558
Morelotia affinis	New Zealand, *Bruhl et al.* JJB 2923 (NE)	–	MW589152	–	–
Morelotia affinis	New Zealand, *Bruhl et al.* JJB 2924 (NE)	–	MW589153	–	–
Morelotia affinis	New Zealand, *de Lange* 8023 (CHR)	KT626742	–	–	–
Morelotia gahniiformis Gaudich.	Hawaii, *Herbst* 1197 (GENT)	EF178576	–	–	–
Morelotia gahniiformis	Hawaii, *Morden* 2117 (PERTH)	–	KF553519	KF553452	–
Morelotia gahniiformis	Hawaii, *Morden s.n.* HPDL2087 (HAW)	–	MW589154	–	–
Morelotia gahniiformis	Hawaii, *Wood* 3197 (PTBG)	–	MW589155	MW605213	–

Name	Voucher	*rbcL*	*trnL-F*	ITS	ETS
Morelotia microcarpa (S.T.Blake) R.L.Barrett & K.L.Wilson	Western Australia, *Barrett & Briggs* RLB 5274 (PERTH)	–	MW589156	–	–
Morelotia octandra (Nees) R.L.Barrett & J.J.Bruhl	Western Australia, *Barrett* RLB 5050A (PERTH)	–	MK511364	–	–
Morelotia octandra	Western Australia, *Hodgon & Bruhl* JH 795 (NE)	–	MW589157	–	–
Morelotia octandra	Western Australia, *Hodgon & Bruhl* JH 809 (NE)	–	MW589158	–	–
Morelotia octandra	Western Australia, *Verboom* 1242 (BOL)	KF553627	KF553531	–	–
Tetraria arundinacea (Sol. ex Vahl) T.Koyama	New Caledonia, *Wilson* 9935 (NSW)	–	AY230036	–	–
Tetraria breviseta (J.Raynal) Larridon	New Caledonia, *Bruhl* JJB 3261 (NE)	–	MF314972	–	–
Tetraria bromoides (Lam.) H.Pfeiff.	S. Africa, *Verboom* 641 (BOL)	–	DQ419851	–	–
Tetraria burmannii (Vahl) C.B.Clarke	S. Africa, *Verboom* 1219 (BOL)	–	KJ545840	–	KJ545771
Tetraria cf. *burmannii*	S. Africa, *Slingsby* 002 (BOL)	–	KJ545835	–	KJ545764
Tetraria capillacea (Thunb.) C.B.Clarke	S. Africa, *Verboom* 1313 (BOL)	–	KJ545842	–	–
Tetraria cernua (Levyns) Larridon	S. Africa, *Verboom* 707 (BOL)	–	KF553506	–	KF553551
Tetraria comosa (C.B.Clarke) T.Koyama	New Caledonia, *Bruhl* JJB 3258 (NE)	–	MH286443	–	–
Tetraria comosa	New Caledonia, *Wilson & Jaffre* 7673 (GENT)	–	MF314973	–	–
Tetraria compressa Turrill	S. Africa, *Verboom* 653 (BOL)	KJ613587	DQ419854	–	KJ545785, KJ613578
Tetraria crinifolia (Nees) C.B.Clarke	S. Africa, *Verboom* 638 (BOL)	DQ058348, KJ545814	DQ058309	–	–
Tetraria eximia C.B.Clarke	S. Africa, *Verboom* 647 (BOL)	KJ545817	KJ545847	–	KJ545783
Tetraria cf. *eximia*	S. Africa, *Verboom* 720 (BOL)	–	–	–	KJ545789
Tetraria cf. *eximia*	S. Africa, *Verboom* 891 (BOL)	–	KJ545850	–	–
Tetraria fasciata (Rottb.) C.B.Clarke	S. Africa, *Verboom* 639 (BOL)	–	KJ545846	–	KJ545779
Tetraria cf. *fasciata*	S. Africa, *Verboom* 644 (BOL)	–	DQ419858	–	KJ545782
Tetraria ferruginea C.B.Clarke	S. Africa, *Verboom* 527 (BOL)	–	KJ545843	–	KJ545776
Tetraria fimbriolata (Nees) C.B.Clarke	S. Africa, *Verboom* 533 (BOL)	–	DQ419862	–	KJ545777
Tetraria flexuosa (Thunb.) C.B.Clarke	S. Africa, *Verboom* 505 (BOL)	–	DQ419859	–	KJ613579, KF553587
Tetraria flexuosa	S. Africa, *Verboom* 733 (BOL)	–	DQ419860	–	KJ545790
Tetraria cf. *flexuosa*	S. Africa, *Kennedy* A (BOL)	–	–	–	KJ545766
Tetraria fourcadei Turrill & Schönland	S. Africa, *Verboom* 633 (BOL)	–	KJ545845	–	KJ545783
Tetraria involucrata (Rottb.) C.B.Clarke	S. Africa, *Verboom* 1283 (BOL)	–	–	–	KF553588
Tetraria involucrata	S. Africa, *Verboom* 661 (BOL)	KF553621	DQ419852	–	KJ545787
Tetraria maculata Schönland & Turrill	S. Africa, *Verboom* 528 (BOL)	–	KJ545844	–	–
Tetraria cf. *maculata*	S. Africa, *Verboom* 763 (BOL)	–	KJ545849	–	–
Tetraria microstachys (Vahl) H.Pfeiff.	S. Africa, *Verboom* 640 (BOL)	DQOS8347, KJ545815	DQ058307	–	KF553589, KJ545780
Tetraria cf. *microstachys*	S. Africa, *Verboom* 513 (BOL)	–	DQ419856	–	KJ545775

Name	Voucher	*rbcL*	*trnL-F*	ITS	ETS
Tetraria nigrovaginata (Nees) C.B.Clarke	S. Africa, *Verboom* 500 (BOL)	–	DQ419857	–	KJ545773, KF553590
Tetraria pubescens Schönland & Turrill	S. Africa, *Verboom* 651 (BOL)	–	DQ419855	–	–
Tetraria cf. *pubescens*	S. Africa, *Verboom* 1280 (BOL)	–	KJ545839	–	KJ545770
Tetraria pygmaea Levyns	S. Africa, *Slingsby* pygsil (BOL)	–	KJ545837	–	KJ545768
Tetraria pygmaea	S. Africa, *Verboom* 1276 (BOL)	–	KJ545838	–	KJ545769
Tetraria cf. *pygmaea*	S. Africa, *Verboom* 1304 (BOL)	–	KJ545841	–	KJ545772
Tetraria raynaliana Larridon	New Caledonia, *Wilson & Jaffre* 7672 (NSW)	–	MF314985	–	–
Tetraria raynaliana	New Caledonia, *Wilson* 9940 (NSW)	–	AY230037	–	–
Tetraria secans C.B.Clarke	S. Africa, *Verboom* 658 (BOL)	KJ545818	KJ545848	–	KJ545786
Tetraria cf. *secans*	S. Africa, *Verboom* 896 (BOL)	–	KJ545851	–	KJ545791
Tetraria setacea (J.Raynal) Larridon	New Caledonia, *McKee* 30273 (P)	–	MF314987	–	–
Tetraria spiralis C.B.Clarke	S. Africa, *Verboom* 719 (BOL)	–	–	–	KJ545788
Tetraria stagnalis (Däniker) T.Koyama	New Caledonia, *Wilson & Jaffre* 7756 (NSW)	–	MF314988	–	–
Tetraria sylvestris (J.Raynal) Larridon	New Caledonia, *McKee* 28051 (P)	–	MF314989	–	–
Tetraria thermalis (L.) C.B.Clarke	S. Africa, *Verboom* 643 (BOL)	KJ613588	DQ058308	–	KJ545781
Tetraria triangularis (Boeckeler) C.B.Clarke	S. Africa, *Britton* 302 (BOL)	–	–	–	KJ613571
Tetraria triangularis	S. Africa, *Britton* 303 (BOL)	–	KJ613554	–	KJ613570
Tetraria triangularis	S. Africa, *Britton* 310 (BOL)	–	–	–	KJ613569
Tetraria triangularis	S. Africa, *Britton* 313 (BOL)	–	–	–	KJ613565
Tetraria triangularis	S. Africa, *Britton* 321 (BOL)	KJ613583	KJ613548	–	–
Tetraria triangularis	S. Africa, *Britton* 322 (BOL)	–	–	–	KJ613566
Tetraria triangularis	S. Africa, *Britton* 343 (BOL)	–	KJ613558	–	KJ613573
Tetraria triangularis	S. Africa, *Britton* 348 (BOL)	–	–	–	KJ613575
Tetraria triangularis	S. Africa, *Britton* 353 (BOL)	–	KJ613561	–	–
Tetraria triangularis	S. Africa, *Britton* 354 (BOL)	KJ613585	KJ613559	–	KJ613574
Tetraria triangularis	S. Africa, *Britton* 359 (BOL)	–	KJ613562	–	KJ613577
Tetraria triangularis	S. Africa, *Verboom* 518 (BOL)	–	DQ419853	–	–
Tetraria triangularis	S. Africa, *Verboom* 782 (PRE)	–	KJ613564	–	–
Tetraria ustulata (L.) C.B.Clarke	S. Africa, *Verboom* 501 (BOL)	KF553625	DQ419861	–	–
Tetraria ustulata	S. Africa, *Verboom* 664 (BOL)	–	–	–	KF553594
Tetraria cf. *ustulata*	S. Africa, *Helme* A (BOL)	–	KJ545836	–	KJ545765
Tetraria wallichiana C.B.Clarke	S. Africa, *Kennedy* B (BOL)	–	–	–	KF545767
Tricostularia aphylla (R.Br.) K.L.Wilson & R.L.Barrett	Western Australia, *Barrett* RLB 2753 (PERTH)	–	MK511365	–	–
Tricostularia aphylla	Western Australia, *Keighery & Gibson* 5082 (PERTH)	–	MK511366	–	MW588447
Tricostularia compressa Nees ex Lehm.	Western Australia, *Davis* 1721 (PERTH)	–	MW589159	MW605214	MW588448
Tricostularia compressa	Western Australia, *Hislop* 2537 (PERTH)	–	MW589160	MW605215	MW588449
Tricostularia compressa	Western Australia, *Hodgon & Bruhl* 812 (NE)	–	MW589167	–	–

Name	Voucher	*rbcL*	*trnL-F*	ITS	ETS
Tricostularia drummondii (Steud.) R.L.Barrett & K.L.Wilson	Western Australia, *Gibson* 4035 (PERTH)	–	MW589161	MW605216	MW588450
Tricostularia exsul (C.B.Clarke) K.L.Wilson & R.L.Barrett	Western Australia, *Barrett* RLB 5020 (PERTH)	–	–	KX963565	–
Tricostularia neesii Lehm.	Western Australia, *Barrett & Briggs* RLB 5302 (PERTH)	–	MW589162	MW605217	MW588451
Tricostularia neesii	Western Australia, *Pryde & Morley* 12 (PERTH)	–	–	–	MW588452
Tricostularia newbeyi	Western Australia, *Byrne* 2545 (PERTH)	–	MW589163	MW605218	MW588453
Tricostularia newbeyi	Western Australia, *Edinger & Marsh* DJE 4094 (PERTH)	–	–	–	MW588454
Tricostularia pauciflora (F.Muell.) Benth.	New South Wales, Australia, *Wilson* 9910 (NSW)	AY725954	AY230038	–	–
Tricostularia pauciflora	New South Wales, *Gibbs et al*. AKG 53 (NE)	–	MW589164	–	KF553597
Tricostularia pauciflora	Victoria, *Gibbs & Fitzgerald* AKG 88 (NE)	–	MW589165	–	–
Tricostularia sandifordiana R.L.Barrett & K.L.Wilson	Western Australia, *Barrett & Gaskell* RLB 5045 (PERTH)	–	MK511369	MW605219	MW588455
Tricostularia sp. Albany (R.L. Barrett & K.L. Wilson RLB 5342)	Western Australia, *Barrett & Wilson* RLB 5342 (PERTH)	–	MW589166	MW605220	MW588456
Tricostularia sp. Albany	Western Australia, *Barrett et al*. RLB 4389 (PERTH)	–	MK511367	MW605221	MW588457
Xyroschoenus hornei (C.B.Clarke) Larridon	Seychelles, *Senterre & Henriette* 7107 (GENT)	–	MF314975	–	MF315012

Laboratory work was conducted at Kings Park & Botanic Garden, Western Australia, and the Jodrell Laboratory, Kew, UK, using slightly different methods. DNA extraction at KPBG followed a modified protocol from Carlson *et al*. (1991) and Csaikl *et al*. (1998). About half a gram of plant material was ground using a mortar and pestle with acid-washed sand in liquid nitrogen until a powder was obtained. One mL of Carlson extraction buffer (Csaikl *et al*. 1998) was added and the liquid transferred to a 1.5 mL Eppendorf tube, to which 0.4 µg RNase A (Qiagen, Hilden, Germany) was added before the samples were incubated in a water bath at 65°C for 15 mins. Samples were then centrifuged at 11,500 rpm for 10 min. The supernatant was transferred to a new 1.5 mL Eppendorf tube and 600 µL of chloroform: isoamyl alcohol (24:1) was added to each sample. Samples were then gently shaken for 30 min. before being centrifuged at 9,000 rpm for 10 min. The supernatant was transferred to a new 1.5 mL Eppendorf tube and an equal volume (approx. 650 µL) of cold isopropanol was added to each sample. This was mixed gently by inversion before the samples were stored in a -20°C freezer for 20 min. Samples were centrifuged at 10,000 rpm for 10 mins before the liquid component was discarded. One mL cold 70% ethanol was added to each sample before they were centrifuged at 13,000 rpm for 10 min. The liquid component was discarded and the samples were air dried for at least two hours. The DNA was re-suspended in 80 µL TE buffer (0.1 M).

At the Jodrell Laboratory, Royal Botanic Gardens, Kew, DNA extractions were performed using 0.2–0.3 g silica dried leaves and a modified version of the 2X CTAB method of Doyle and Doyle (1987). Before precipitation, an aliquot was purified using QIAgen PCR purification kit (QIAgen, Crawley, West Sussex, UK) following the manufacturer's protocols. The total DNA was further purified for long-term storage in the DNA Bank at RBG Kew using a caesium chloride/ethidium bromide gradient (1.55g/ml) followed by a dialysis procedure.

DNA amplification

At Kings Park, DNA was amplified using polymerase chain reaction (PCR) with a total volume of 50 µL. Each PCR contained 10 µL 5× polymerisation buffer (Fisher Biotech, Subiaco, WA, Australia), and a final concentration of 2 mM $MgCl_2$ (Fisher Biotech), 0.12% DMSO (Merck, Kilsyth, VIC, Australia), 0.06% BSA (Sigma Aldrich, St Louis, MO, USA), 5 µM each of the forward and reverse primers, and 0.2 U Taq DNA polymerase (Fisher Biotech). Primers used are listed in Table 4 (note that no new *rbcL* data was generated).

Table 4. Primers used to amplify DNA for sequencing.

Region	Primer	Reference
ETS1-F	CTGTGGCGTCGCATGAGTTG	Starr *et al.* 2003
18S-R	AGACAAGCATATGACTACTGGCAGG	Starr *et al.* 2003
ITS1	GCATATCAATAAGCGGAGGA	White *et al.* 1990
ITS4	TCCTCCGCTTATTGATATGC	White *et al.* 1990
*trn*Lc	CGAAATCGGTAGACGCTACG	Taberlet *et al.* 1991
*trn*Ld	GGGGATAGAGGGACTTGAAC	Taberlet *et al.* 1991
*trn*Le	GGTTCAAGTCCCTCTATCCC	Taberlet *et al.* 1991
*trn*Ff	ATTTGAACTGGTGACACGAG	Taberlet *et al.* 1991

PCRs were variously run on GeneAmp (Applied Biosystems, Foster City, CA, USA) or Palm-Cycler (Corbett Life Science, Concord, NSW, Australia) thermal cyclers using the following cycle for ETS: Hold: 95°C for 90 s, then 35 cycles of: 95°C for 30 s; 50°C for 60 s; 72°C for 90 s; hold 72°C for seven mins and finally hold indefinitely at 4°C. The PCR products were purified using AMPure beads (Agencourt Bioscience, Beverley, Massachusetts, USA).

At the Jodrell Laboratory, cycle sequencing reactions were carried out using the BigDye Terminator Mix (Applied Biosystems, ABI, Warrington, Cheshire, UK). Products were run on an ABI 3100 Genetic Analyser or an ABI 377 automated sequencer according to the manufacturer's protocols. Both strands were sequenced for each region. Additional sequencing was variously performed at AGRF (Brisbane, Australia), or by Macrogen Inc. (Seoul, Republic of Korea).

Phylogenetic analyses

A phylogeny of the *Tricostularia* clade has been reconstructed here using the external transcribed spacer (ETS) and internal transcribed spacer (ITS) regions of nrDNA, *rbcL* gene and the *trnL* intron and *trnL–F* spacer of cpDNA. Sequences were edited using CodonCode Aligner software (CodonCode Corp., Dedham, Massachusetts, USA) and checked with BLAST (http://blast.ncbi.nlm.nih.gov/Blast.cgi) to ensure that the sequences produced were not from a contaminated source. Sequences were then manually aligned in Geneious (ver. 9.1.7, see https://www.geneious.com, accessed April 2018). Phylogenetic analyses were performed using Bayesian inference implemented in MrBayes (ver. 3.2.6, see https://github.com/NBISweden/MrBayes/releases/tag/v3.2.6; Huelsenbeck and Ronquist 2001; Ronquist *et al.* 2012). *Gahnia deusta* (R.Br.) Benth. was designated as outgroup for all analyses, with two samples of this and three additional *Gahnia* species included to minimise long-branch attraction to the outgroup. Four Markov-Chain Monte Carlo (MCMC) chains were run for 1.5 million generations, with one tree sampled every 250 generations at a temperature of 0.2 with default priors (gamma), and GTR substitution model, GTR+G being consistent with the analyses of Semmouri *et al.* (2019) using the same markers within Cyperaceae. Subsequent analyses were performed using the optimal models GTR+I+G for ETS and HKY+I for *rbc*L (identified by the Akaike Information Criterion corrected for small sample sizes in jModelTest; Posada 2008) and these models were also applied to the concatenated analysis, but no significant diffrences in topology or support values were identified. The first 200,000 trees recovered were discarded as burn-in (trees produced before convergence).

Results

The sequence data comprised 67 sequences for ETS, 19 for ITS, 20 for *rbcL* and 91 for *trnL-F*, each including up to 8 outgroup samples (all *Gahnia* species; see Table 3). Alignment and character statistics are shown in Table 5. As no well-supported conflicts among the different markers were found, a reduced concatenated dataset (supermatrix) of 58 samples, including 6 outgroup samples, was constructed to test support for the backbone nodes based on all four sequence regions. In most cases, a single sample was used for all sequence regions, but in a few cases, samples were pooled in the concatenated analysis where specific regions were otherwise missing from the supermatrix. Most samples are represented by at least two markers in the supermatrix, but to ensure the diversity of the subtribe was represented in the phylogeny, several important samples were included on the basis of single available markers only.

Table 5. Descriptive statistics for individual and concatenated marker alignments.

	ETS	ITS	*trnL-F*	Concatenated (with 20 *rbcL* sequences)
Number of samples (new)	67 (16)	19 (12)	91 (22)	55 (–)
Sequence length range (bp)	415–555	421–679	376–987	603–3,202
Aligned length (bp)	556	690	989	3,295
GC content (%)	59.7	66.8	28.1	40.4
Variable sites	489	225	628	2,099
Missing sequences	–	–	–	94/220 (43%)
Gaps + missing characters (%)	8.3	7.5	11.3	36.3

Phylogeny based on concatenated data

The monophyly of five of the six genera recognised here is supported with posterior probability (PP) of 1 or 0.99 in our concatenated analysis. *Xyroschoenus* is only represented by a single sample on a long branch, and it is weakly placed as sister to *Morelotia* (Figure 1).

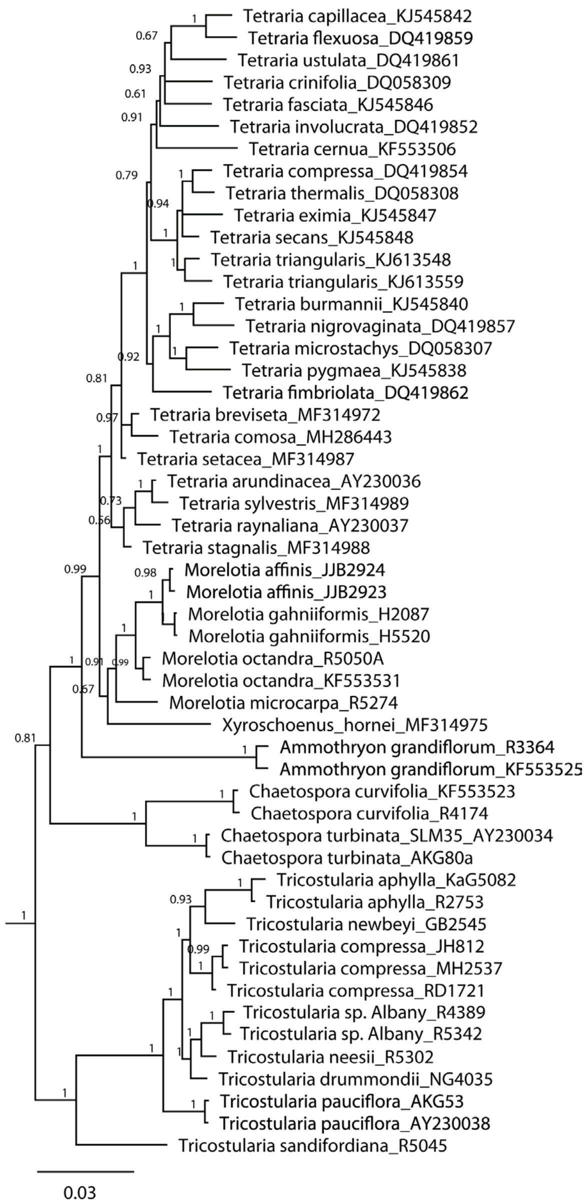

Fig. 1. Phylogeny of selected Schoeneae inferred from concatenation of *rbcL* and *trnL-F* (cpDNA), ITS and ETS (nrDNA) data. Posterior output from MrBayes. Numbers above lines are posterior probability. *Gahnia deusta* was designated as outgroup; *G. trifida* and *G. tristis* were also included to reduce long-branch attraction to the outgroup (not shown due to long branch-lengths).

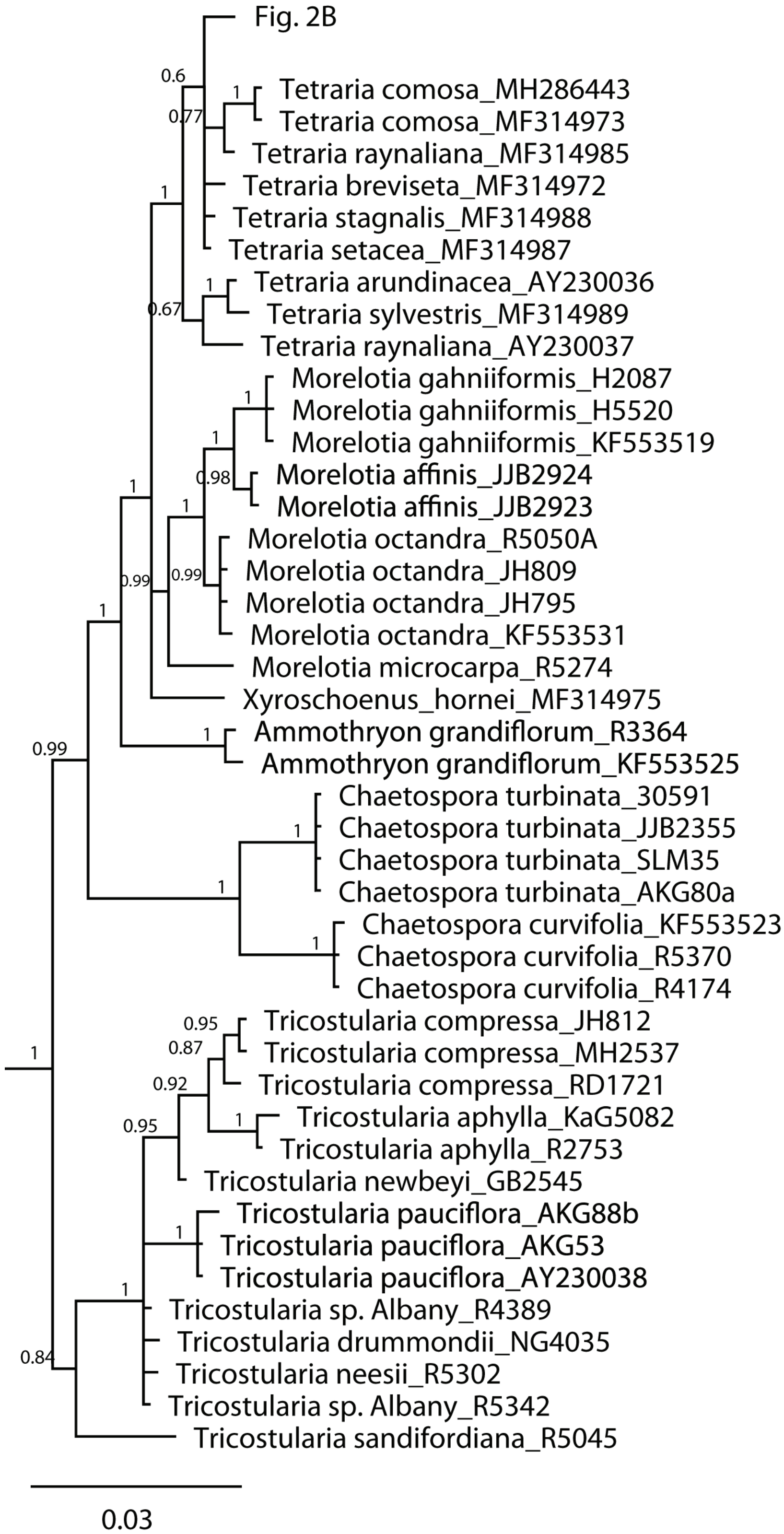

Fig. 2A. Phylogeny of selected Schoeneae inferred from *trnL* intron and *trnL–F* spacer data (cpDNA). Posterior output from MrBayes. Numbers above lines are posterior probability. *Gahnia deusta* was designated as outgroup; *G. radula*, *G. trifida* and *G. tristis* were also included to reduce long-branch attraction to the outgroup (not shown due to long branch-length).

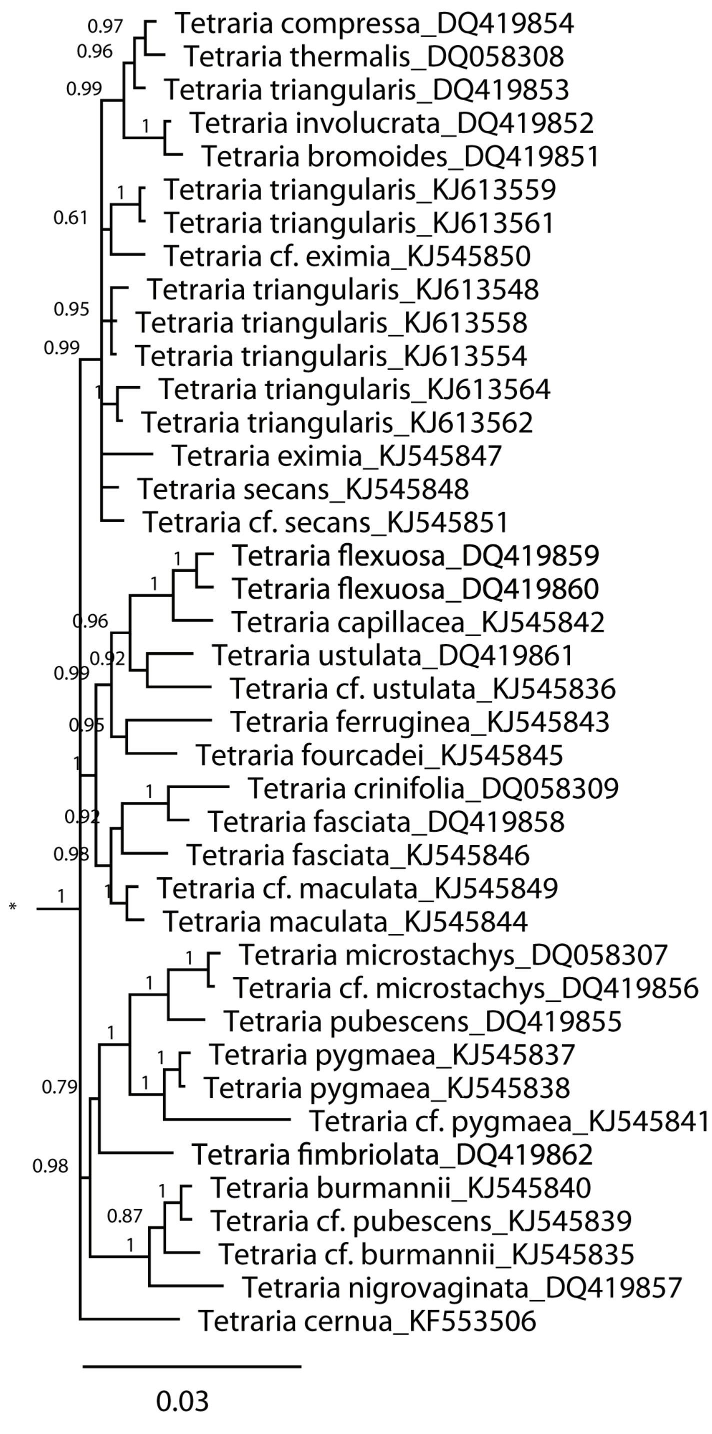

Fig. 2B. Phylogeny of selected Schoeneae inferred from *trnL* intron and *trnL–F* spacer data (cpDNA). Posterior output from MrBayes. Numbers above lines are posterior probability. *Gahnia deusta* was designated as outgroup; *G. radula*, *G. trifida* and *G. tristis* were also included to reduce long-branch attraction to the outgroup (not shown due to long branch-length).

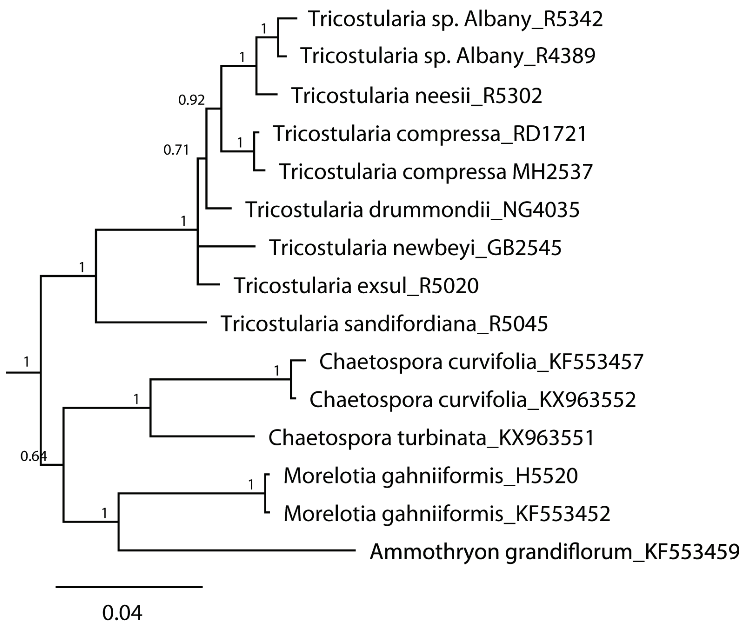

Fig. 3. Phylogeny of selected Schoeneae inferred from ITS data (nrDNA). Posterior output from MrBayes. Numbers above lines are posterior probability. *Gahnia deusta* was designated as outgroup; *G. radula*, *G. trifida* and *G. tristis* were also included to reduce long-branch attraction to the outgroup (not shown due to long branch-length).

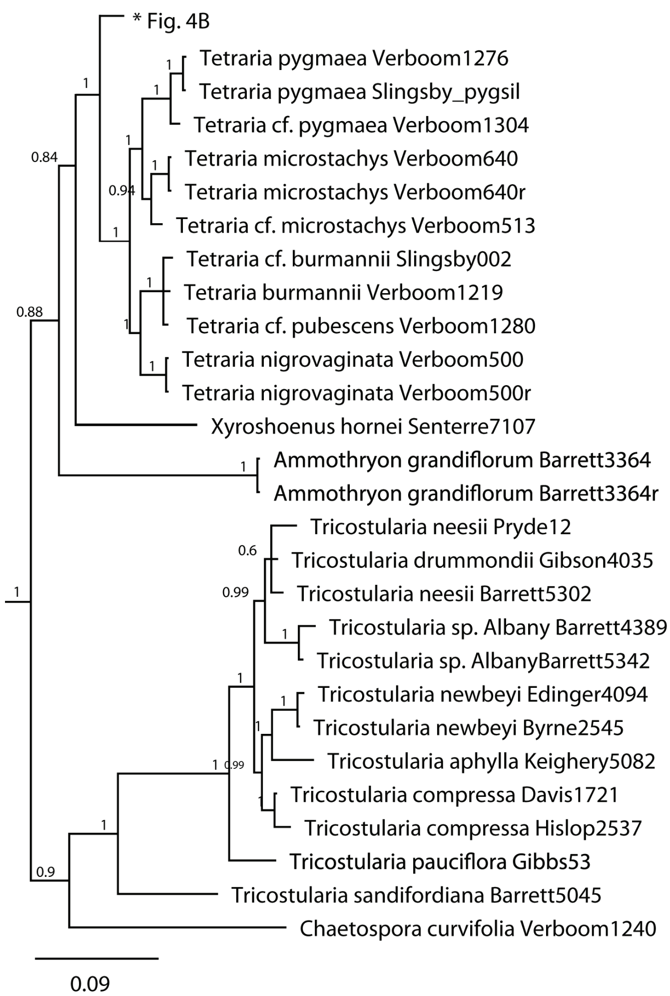

Fig. 4A. Phylogeny of selected Schoeneae inferred from ETS data (nrDNA). Posterior output from MrBayes. Numbers above lines are posterior probability. *Gahnia deusta* was designated as outgroup; *G. radula*, *G. trifida* and *G. tristis* were also included to reduce long-branch attraction to the outgroup (not shown due to long branch-length).

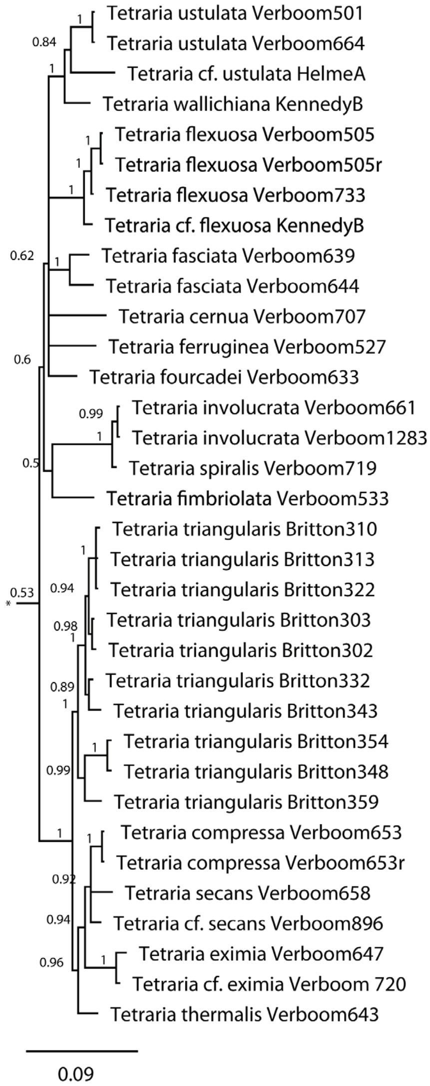

Fig. 4B. Phylogeny of selected Schoeneae inferred from ETS data (nrDNA). Posterior output from MrBayes. Numbers above lines are posterior probability. *Gahnia deusta* was designated as outgroup; *G. radula*, *G. trifida* and *G. tristis* were also included to reduce long-branch attraction to the outgroup (not shown due to long branch-length).

Tricostularia (excluding *Anthelepis*) is strongly supported as a monophyletic genus (PP 1), sister to the remainder of the Tricostulariinae (PP 0.81; Figure 1). *Tricostularia sandifordiana*, a species whose generic placement has been questioned due to its gross morphology resembling species of Restionaceae, is strongly supported as sister to all other *Tricostularia* species (PP 1). The inclusion in *Tricostularia* of *Tricostularia aphylla* and *T. exsul* is strongly supported (PP 1); these two species were transferred from *Lepidosperma* Labill. by Barrett and Wilson (2012).

Chaetospora, recently reinstated and redefined by Barrett *et al.* (2020) to include three southern Australian species, is also strongly supported as monophyletic (PP 1) and is possibly the next-diverging lineage in Tricostulariinae, but this relationship is not supported by our analyses (P 0.81; Figure 1).

Ammothryon grandiflorum is fully supported as sister to a clade containing *Xyroschoenus*, *Morelotia* and *Tetraria* (PP 1; Figure 1).

The monotypic, geographically isolated and morphologically distinctive *Xyroschoenus*, endemic to the Seychelles (Larridon *et al.* 2018a), is possibly sister to *Morelotia* in our analyses but this relationship is not supported (P 0.67).

A key finding is the placement of *Tetraria microcarpa* (not previously sequenced), strongly supported as sister to both *Tetraria* (*Tetrariopsis*) *octandra* and *Morelotia* (PP 0.98). *Morelotia* in its traditional circumscription (*M. affinis* and *M. gahniiformis*) is fully supported as monophyletic (PP 1).

Tetraria (*sensu* Larridon *et al.* 2018b) is strongly supported as monophyletic (PP 1). A number of the internal nodes remain poorly supported, especially for the New Caledonian taxa; however, they are only represented by *trnL-F* data.

Discussion

Analysis of nuclear data generated with the Angiosperms353 bait kit, including near-complete generic representation across Cyperaceae, has resolved tribe Schoeneae as monophyletic, with strong support for eight internal clades (Larridon *et al.* 2021b). These eight clades will be recognised as subtribes to facilitate analysis and discussion of the extensive morphological diversity found within the tribe, especially given significant confusion over past generic delimitation (Slingsby and Verboom 2006; Bruhl *et al.* 2008a, 2008b; Wilson *et al.* 2012; Viljoen *et al.* 2013; Muasya 2016; Musili *et al.* 2016; Barrett *et al.* 2017, 2019, 2020a, 2020b; Larridon *et. al.* 2018a, 2018b, 2019; Semmouri *et al.* 2019). The subtribe Tricostulariinae is formally described here so that a valid subtribal name is available.

The molecular data and analyses presented here provide evidence for a narrowed circumscription of the genus *Tricostularia*. Several species traditionally included in *Tricostularia* are now excluded from the genus and we return to the concept of Kükenthal (1944). *Tricostularia guillauminii* (Kük.) J.Raynal, *Tricostularia paludosa* (R.Br.) Benth. and *Tricostularia undulata* (Thwaites) J.Kern have been placed in the new genus *Anthelepis* R.L.Barrett, K.L.Wilson & J.J.Bruhl (Barrett *et al.* 2019). With the exclusion of these species, *Tricostularia* forms a well-supported monophyletic group. The morphologically anomalous *Tricostularia sandifordiana* is on a long branch relative to other species, but recognition of an additional genus does not appear justified on morphological grounds.

It is evident that current species concepts are variously monophyletic, polyphyletic or paraphyletic, which, in combination with expressed morphological diversity, suggests that additional species need to be recognised. Additional sampling is required to determine the relationships among all of the morphotypes observable in herbarium collections and to determine the extent of genetic variation within each taxon.

The genus *Tricostularia* as defined here is characterised by culms commonly noded with leaf lamina usually reduced to bracts. The inflorescence is small and spike- or head-like. There is considerable morphological variation in specimens historically assigned to *Tricostularia compressa* and *T. neesii* and new species are recognised here. A number of the morphotypes currently held at NSW and PERTH are poorly represented and a full taxonomic revision will require additional fieldwork to assess taxonomic boundaries in some taxa.

There is considerable genetic divergence between the western species *Chaetospora curvifolia* and the eastern species *C. turbinata* (*C. subbulbosa* has not been sequenced, but is expected to be sister to *C. curvifolia* based on morphological similarity and geographic distribution).

Ammothryon grandiflorum, long included in the genus *Schoenus* as a morphologically anomalous species (Mueller 1875; Rye 1987; Wheeler and Graham 2002), is strongly supported as sister to the *Xyroschoenus*–*Morelotia*–*Tetraria* clade, justifying its recognition here as a new, monotypic genus which also finally renders *Schoenus* monophyletic (see Elliott *et al.* 2021).

Based largely on biogeography, it had been expected that *Tetraria microcarpa* and *Tetrariopsis octandra* would form a clade sister to *Morelotia*. Bruhl (1995) first recovered *Morelotia* and *Tetrariopsis* as sister taxa based on morphology. The results here, based on molecular data, raise the question whether the two should be united in one genus. *Tetraria microcarpa* is here resolved as sister to both *Tetrariopsis* and *Morelotia*, so the only alternative to create monophyletic lineages would be the description of *Tetraria microcarpa* as a distinct genus. We do not consider that warranted on morphological grounds, the key difference of that species being an overall reduction in size rather than morphological synapomorphies. Larridon *et al.* (2018a) continued to distinguish *Morelotia* and *Tetrariopsis*, and provided a key to differences; 8 stamens (3–)4(–5) style branches, and mature fruit deciduous for *Tetrariopsis octandra*, *vs* 3 stamens, 3 style branches, and fruit persistently attached by old style filaments for *Morelotia*. However, on closer morphological study of the three Western Australian species, and the addition of *Morelotia involuta* from Rapa Iti (Barrett *et al.* 2021b), these differences do not hold. We conclude that a single genus is the best option to accommodate the six species of this clade within the generic classification of the Tricostulariinae, given the level of morphological variation they express. We choose to expand the definition of the genus *Morelotia* to include *Tetraria australiensis*, *T. microcarpa* and *T. octandra*.

We here present the first generic description of the genus *Tetraria* based on the circumscription outlined by Larridon *et al.* (2018b). Additional markers should be generated to resolve relationships within *Tetraria* and to improve our understanding of long-distance dispersal patterns within the genus.

Taxonomy

Tricostulariinae R.L.Barrett, K.L.Wilson & J.J.Bruhl, *subtribus nov*.

Type genus: *Tricostularia* Nees ex Lehm.

Diagnostic characters: Distinguished from other clades in tribe Schoeneae by the following combination of characters: Tufted, rhizomatous, perennial graminoids; leaves basal and commonly cauline, sometimes on an erect caudex (*Ammothryon*, some *Tetraria* and *Xyroschoenus*); culms trigonous or terete; leaf laminas well-developed or much reduced; eligulate; leaf margins scaberulous to denticulate, flat to channelled, sometimes V- or M-shaped in section, sometimes involute or revolute; inflorescence terminal, panicle-like, sometimes appearing head-like (*Chaetospora*, some *Tricostularia*) or spike-like (some *Tricostularia*); spikelet prophyll present at base of spikelets (except *Ammothryon*), glumes distichous, mostly persistent (deciduous in *Tricostularia*); rachilla mostly non-flexuous, straight (elongate and curved around nutlet in *Morelotia affinis*, *M. gahniiformis*, *M. octandra* and *Xyroschoenus*); flowers subtended by upper glumes (except upper glume reduced and infertile in Pacific species of *Morelotia*); lower flower(s) variously bisexual fertile, functionally male or bisexual sterile, upper bisexual or functionally male (*Morelotia octandra*); upper glumes longer than lower; spikelets ranging from few to many in spikelet clusters; perianth absent or bristles 2, 6, or 7–8, shorter or longer than the nutlet; mostly 3 stamens [(3)6 in *Morelotia australiensis*, (4, 6)8(9) in *M. octandra*], stigma mostly 3-fid (3- or 4-fid in some species of *Tetraria*, 3–5-fid in *Morelotia octandra*); nutlets ranging in shape from ovoid to broad ellipsoid or globose.

Constituent genera: *Ammothryon* R.L.Barrett, K.L.Wilson & J.J.Bruhl (1 sp.), *Chaetospora* R.Br. (3 spp.), *Morelotia* Gaudich. (6 species), *Tetraria* P.Beauv. (*c.* 39 spp.), *Tricostularia* Nees ex Lehm. (*c.* 16 species, several undescribed), and *Xyroschoenus* Larridon (1 sp.).

Morphological diversity: Directly comparable character coding for all or representative species for each genus is presented in Appendix 1.

Distribution: Southern Australia (*Ammothryon*, *Chaetospora*, *Tricostularia*); South-western Australia, New Zealand, French Polynesia, Hawaiian Islands (*Morelotia*); New Caledonia to Borneo and New Guinea, Cape Floristic Region to tropical Africa (*Tetraria*); the Seychelles (*Xyroschoenus*).

Notes: Pollen morphology in the subtribe is poorly known and no representatives were examined by Nagels *et al.* (2009) in their review of the family. Moar and Wilmshurst (2003) in their review of New Zealand Cyperaceae pollen describe the pollen of *Morelotia affinis* as 'similar' to *Gahnia*, but do not provide specific characterisation for the species. Examination by light microscopy under phase contrast of *Tricostularia aphylla* pollen found that it is prolate (or pear-shaped), lacks a distal aperture and has 3 lateral apertures (these being ovate and recessed).

Key to the genera of subtribe *Tricostulariinae*

1. Prophyll below spikelet absent; spikelets 12–22 mm long, with 10–14 glumes and 4 bisexual flowers; perianth absent; anthers 7–10 mm long .... ***Ammothryon***

1. Prophyll below spikelet present; spikelets 2.8–25 mm long, with 4–9 glumes and 1–3 bisexual flowers; perianth present or absent; anthers 0.8–6.5 mm long 2

2. Culms with 5–10 nodes below the inflorescence; caudex present; inflorescence 10–35 cm wide, branches arcuate; rachilla curved around nutlet; perianth segments (6)7 or 8, 5–6 mm long .... ***Xyroschoenus***

2. Culms with 0–5 nodes below the inflorescence; caudex usually absent (present in some *Tetraria* spp.); inflorescence 0.3–10 cm wide, branches erect to spreading (sometimes arcuate in *Tetraria*); rachilla usually not curved around nutlet (curved in some *Morelotia* spp.); perianth segments 0, 2 or 6, 0–5 mm long 3

3. Leaf lamina reduced, usually <1 cm long (rarely up to 7 cm); involucral bracts reduced, bract-like; inflorescence slender or contracted, panicle-like or head-like, 0.8–15 cm long .... ***Tricostularia***

3. Leaf lamina well-developed, 4–100 cm long; involucral bracts leaf-like; inflorescence open, elongate or dense, panicle-like or head-like or subglobular, 0.5–1.5 or 5–70 cm long 4

4. Culms without nodes; leaf lamina 0.3–0.9 mm wide; inflorescence head-like or subglobular, 0.5–1.5 cm long; branchlets compact, hidden .... ***Chaetospora***

4. Culms with 0–5 nodes; leaf lamina (0.5–)1–20 mm wide; inflorescence open, elongate or dense, panicle-like, 5–70 cm long; branchlets obvious, erect to spreading 5

5. Nutlets ± sessile (shortly stipitate in *M. microcarpa*, which differs from *Tetraria* in having a glabrous style base) .... ***Morelotia***

5. Nutlets distinctly stipitate .... ***Tetraria***

Ammothryon R.L.Barrett, K.L.Wilson & J.J.Bruhl, ***gen. nov.***

Type species: *Ammothryon grandiflorum* (Nees ex Lehm.) R.L.Barrett, K.L.Wilson & J.J.Bruhl (based on *Elynanthus grandiflorus* Nees ex Lehm.).

Perennial tufted herbs, 0.7–1.5 m high; rhizome thick, 10–22 mm diam., sometimes pseudobulbous; roots sand-binding; plants clonal, 0.3–1 m across; caudex present; old leaf sheaths covering the caudex, not breaking apart into fibres with age, pale brown to reddish brown. *Culms* stout, erect, leafy, with 4–7 nodes, obtusely trigonous, 2.5–7 mm diam., somewhat ribbed, usually scabrous but otherwise glabrous, base enlarged. *Leaves* basal and cauline, numerous, reducing in size up the culm, ultimately bract-like; phyllotaxy loosely spirotristichous, sheath scabrous, especially on upper leaves, loose around culm, 20–28(–38) mm long, not broader than the leaf lamina, upper margin with short, thick, brownish hairs, ligule absent; lower leaf lamina (150–)220–460 mm long, 5–15 mm wide, lamina ± linear, flat or usually folded, margins and prominent midrib scabrous, apex gradually attenuate. *Inflorescence* open, panicle-like, narrow, 120–750 mm long, 20–45 mm wide; with 7–14 nodes, bracts leaf-like, exceeding the spikelet clusters; branches spreading, with (1–)3–12 spikelets on peduncles 7–16 mm long, arising in each bract axil; spikelet prophyll absent. *Spikelets* brown, very narrowly ovate, 12–22 mm long, with 10–14 glumes, finely and very shortly hairy, only topmost 2–4 fertile, all bisexual, basal glumes 3–6 mm long; fertile glumes 11–20 m long, glabrescent, acute, becoming acuminate; rachilla compact and not or scarcely sinuous in fruiting spikelets. *Perianth* absent. *Stamens* 3; anther connective 6–11 mm long, linear to subulate; anthers pale yellow, 7–10 mm long, with a glabrous apical appendage 1.0–1.5 mm long. *Style* 16–22 mm long, trifid; base 8–12 mm long, slightly enlarged so continuous with the nutlet, branches 8–10 mm long, hairy. *Nutlet* sessile, subovoid but base contracted, 3.2–3.8 mm long, 1.8–2.2 mm diam., with three white ribs that broaden towards the apex; embryo not examined. Photosynthetic pathway inferred from anatomy to be C_3 (*Fitzgerald NSW 4337*; *Salasoo 4017*; Bruhl and Wilson 2007). 1C = 0.39 pg (*Barrett RLB 7785*; Bureš *et al*. 2013).

Diagnostic characters: Related to *Morelotia* Gaudich., *Xyroschoenus* Larridon and *Tetraria* P.Beauv., but distinguished from all of these genera by the combination of the spikelet prophyll below spikelet apparently absent; spikelets 12–22 mm long, with 10–14 glumes and 4 bisexual flowers; perianth absent; and anthers 7–10 mm long. There are superficial morphological similarities to the larger New Caledonian species of *Tetraria*, including *T. comosa* (C.B.Clarke) T.Koyama and *T. raynaliana* Larridon.

Distribution: A single species endemic southern Western Australia.

Etymology: From the Greek *ammos* (sand) and *thryon* (rush), [neuter] in reference to the habitat of this genus, in sandy heath and woodland.

Notes: Larridon *et al.* (2018a) estimated the crown node of the *Ammothryon* lineage at around 22 Ma.

Kükenthal (1938) placed *Schoenus grandiflorus* in *Schoenus* sect. *Stricti* Benth., next to the eastern Australian species *S. villosus* R.Br., which he readily distinguished by the short rhizome, culms with only 1 or 2 nodes, slender, canaliculate leaves, villose sheath margins, spikelets 8–10 mm long, with 4–5 empty glumes that are dark brown. The similarity is superficial.

Ammothryon grandiflorum (Nees ex Lehm.) R.L.Barrett, K.L.Wilson & J.J.Bruhl, *comb. nov*.

Basionym: *Elynanthus grandiflorus* Nees ex Lehm., *Nov. Stirp. Pug.* 54 (1844). *Schoenus grandiflorus* (Nees ex Lehm.) F.Muell., *Fragm*. 9(73): 30 (1875).

Type citation: 'Crescit in locis arenosis calcareisque haud procul ab ora maritima (Perth). (Herb. Preiss. no. 1781).'

Type: Western Australia: Perth, in locis arenosus calcareisque haud procul a bora maritima [in sandy, calcareous places not far from the coast], 9 June 1840, *L. Preiss* [*Plantae Preissianae* No. 1781] (lectotype (here designated): LD 1732115; isolectotypes: B (2 sheets), BM 000900956, G 00195328, G 00195329, HBG 1522312, L 0042719, L 0042720, MEL 2295791, MEL 2295792, NY 00021817, P 00585272).

Illustrations: Clarke (1909: tab. LXXVIII(5, 6), p. 78); Scott and Negus (2002: fig. 1, p. 27); Wheeler and Graham (2002: fig., p. 296); Barrett and Tay (2015: pl. 1–5, p. 201).

Description: As for the genus. (Figure 5).

Diagnostic characters: As for the genus.

Distribution: Endemic to the South West Botanical Province in Western Australia, in near coastal areas from Kalbarri south and east to Israelite Bay.

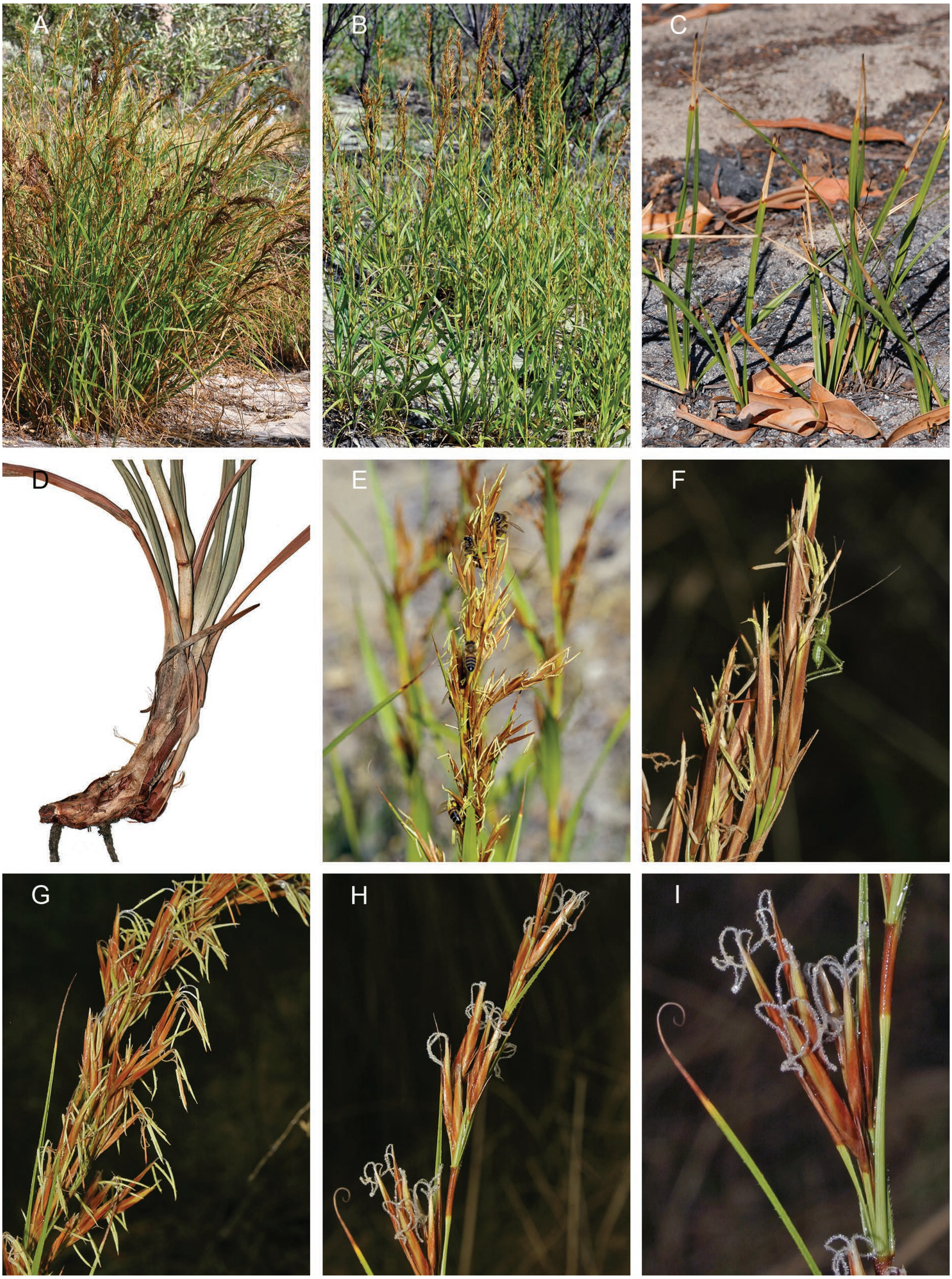

Fig. 5. *Ammothryon grandiflorum*. Kings Park, Perth, Western Australia. A, B. Habit. C. Plants resprouting following fire. D. Plant base showing sand-binding roots, rhizome and leaf bases. E. Staminate inflorescence with honeybees. F. Staminate inflorescence with pollen-feeding katydid. G. Floriferous staminate inflorescence. H. Inflorescence with emergent styles. I. Spikelets with emergent styles. Voucher, *R.L. Barrett 7785* (PERTH). Photos by R.L. Barrett.

Habitat: Occurs close to the coast on sandplains, consolidated sand dunes and limestone in *Banksia* and jarrah-marri woodland, occasionally extending inland along rivers. Recorded in association with *Acacia lasiocarpa*, *A. pulchella*, *Allocasuarina fraseriana*, *A. humilis*, *Anthocercis littorea*, *Banksia attenuata*, *B. ilicifolia*, *B. menziesii*, *B. sessilis* subsp. *sessilis*, *Chaetospora curvifolia*, *Conostephium pendulum*, *Conostylis candicans*, *Corymbia calophylla*, *Eucalyptus marginata*, *Gastrolobium nervosum*, *Gompholobium tomentosum*, *Hibbertia hypericoides*, *H. subvaginata*, *Lepidosperma calcicola*, *L. gladiatum*, *L. scabrum*, *Leucopogon parviflorus*, *Lomandra maritima*, *Macrozamia fraseri*, *Melaleuca systena*, *Mesomelaena pseudostygia*, *Morelotia octandra*, *Schoenus* spp., *Stirlingia latifolia*, *Synaphea spinulosa*, *Templetonia retusa* and *Xanthorrhoea preissii*.

Phenology: Flowers recorded for (March–)April–July. Fruit recorded from July–October.

Selected specimens examined: WESTERN AUSTRALIA: Bold Park, 200 m W of pine plantation, N of Wollaston College, *c.* 8 km W of Perth CBD, 07 June 2006, *R.L. Barrett RLB 3364* (PERTH); corner of Kings Park Road and Thomas Street, 100 m SE of walking track, Kings Park, West Perth, 17 July 2012, *R.L. Barrett RLB 7785* (PERTH); Kalbarri, 5 May 1987, *D. & B. Bellairs 2190* (CANB, PERTH); Cottesloe, near the coast, 25 Aug. 1947, *S.T. Blake 18009* (BRI, CANB, MEL, NSW, PERTH); Denmark wind farm access road, within 50 m of the access gate, 14 Mar. 2017, *G. Byrne 6176* (PERTH); Two Mile Beach, *c.* 6.5 km E of Hopetoun, 28 Sept. 1985, *M. Carter 260* (CANB, PERTH); 5 km S of Cuthbert, 9 Dec. 1996, *R. Davis 1690* (NSW, PERTH); near Perth, Apr. 1901, *W.V. Fitzgerald s.n.* (NSW 74337); N boundary of Reserve A8429 in Leeuwin-Naturaliste National Park (Plot: mr5), 12 Jan. 1990, *N. Gibson & M. Lyons 312* (PERTH); Deep River, Irwins Inlet, Nov. 1912, *S.W. Jackson s.n.* (NSW 74333); Yallingup, 30 Mar 1982, *G.J. Keighery 4543* (CANB, PERTH); Zuytdorp National Park, 0.75 km E from track that parallels coast from State Barrier Fence, on track to Zuytdorp Wreck Site (Site: zu11), 18 Aug. 1995, *G.J. Keighery & N. Gibson 871* (PERTH); 8.9 km S on Moore road from turnoff, 77 km E Geraldton on Geraldton–Mullewa road, 7 Apr. 1992, *K.F. Kenneally 11137* (PERTH); Geraldton, Oct. 1909, *J.H. Maiden s.n.* (NSW 74330); Between Murchison River and Shark Bay, Oct. 1877, *F. Mueller s.n.* (MEL 2202448); 1 km E of Mount Barren, 8 Feb. 1974, *K.R. Newbey 4057* (AD, CANB, MEL, NSW, PERTH); Prevelly Park (Baudin Drive), 10 km W of Margaret River, 30 June 2001, *J. Scott 400* (PERTH); Star Swamp Reserve, Greater Perth, 8 Sept. 2007, *G.A Verboom 1269* (BOL, *n.v.*; PERTH); point at John Cove, Bremer Bay, 16 Dec. 1979, *K.L. Wilson 2915* (NSW, PERTH); 11 km E of Greenhead turn-off on road to Brand Highway and Coorow, 9 Nov. 1994, *K.L. Wilson 8847 & K. Frank* (NE, NSW, PERTH, PRE, SI); Coorow Green Head Road 9.1 km E from junction with Indian Ocean Drive, at Knights Track turn-off, 12 Sep. 2012, *K.L. Wilson 10820 & A. Wilson* (NE, NSW, NY, PERTH); Israelite Bay, *c.* 200 km ENE of Esperance, 19 May 1967, *P.G. Wilson 5862* (NSW, PERTH).

Notes: Perhaps most similar in general appearance to the much smaller *Morelotia octandra*, which is very distinctive in usually having eight anthers (*vs* three), and spikelets 10–15 mm long with 7(–9) glumes (*vs* 12–22 mm long with 10–14 glumes).

A collection at CGE, labelled as *Preiss 134* and the locality given as 'in arenosis Boots Creek ad fluvium Canning' is very similar to the lectotype material and is probably a duplicate of it. The label probably reflects Preiss' field collection number, distributed to Lindley (now in CGE) before Lehmann allocated *Plantae Preissianae* numbers to the collection (see McGillivray 1975; Nordenstam 1980; Crisp 1983; Wilson 1983; Lander 1987; Marchant 1990).

Ammothryon grandiflorum is persistent the landscape due to its clonal growth, with individuals tracked for over 30 years in Kings Park, Perth, and observed to resprout very quickly post-fire (Baird 1977).

This species has the common name of Large Flowered Bog-rush.

Chaetospora R.Br., *Prodr.* 232 (1810), *non* C.Agardh (1824), *non* Faurel & Schotter (1965). *Schoenus* sect. *Chaetospora* (R.Br.) Kuntze in Post & Kuntze, *Lex. Gen. Phan.* 507 (1903).

Type species: *Chaetospora curvifolia* R.Br., designated by Barrett *et al. Telopea* 23: 96 (2020).

=*Ptilanthelium* Steud., *Syn. Pl. Glumac.* 2(8–9): 166 (1855).

Type species: *Ptilanthelium chauvinii* Steud. (= *Chaetospora turbinata* R.Br.).

=*Schoenus* subg. *Pseudomesomelaena* Kük., *Repert. Spec. Nov. Regni Veg.* 44: 180 (1938).

Type species: *Schoenus curvifolius* (R.Br.) Poir. (= *Chaetospora curvifolia* R.Br.), designated by Barrett *et al. Telopea* 23: 96 (2020).

=*Schoenus* sect. *Sphaerocephali* Benth., *Fl. Austral.* 7: 358 (1878) (as *Sphaerocephalae*).

Type species: *Schoenus curvifolius* (R.Br.) Poir. (= *Chaetospora curvifolia* R.Br.), designated by Barrett *et al.* *Telopea* 23: 96 (2020).

Perennial tufted herbs, 0.1–0.55 m high; plants clonal, usually forming dense tussocks 0.05–0.2 m across; rhizome thin, woody, short, branched, 0.8–3.4 mm diam., pseudobulbous; old leaf sheaths covering the rhizome, usually breaking apart into fine fibres with age, straw-coloured to reddish brown; roots sand-binding or not. *Culms* slender, rigid, erect, 11–53 cm tall, 0.6–2.5 mm broad, not noded, terete to compressed, usually sulcate when dried, smooth, glabrous, green to yellow-green, base not enlarged. *Leaves* all basal, numerous; phyllotaxy loosely spirotristichous; phyllotaxy loosely spirotristichous; sheath 20–70 mm long, 0.7–2.7 mm wide, broader than the leaf lamina, glabrous or scabrid, straw-coloured to reddish-brown, dull, upper margin membranous, oblique, ligule absent; cauline sheath tight around culm; *pseudopetiole* obscure or absent; leaves with a well-developed lamina, not exceeding the culms, lamina dorsiventral, 4–21 cm long, 0.3–0.9 mm wide; bases white or brown-membranous, sometimes dividing; lamina ± linear, flat to channelled above, ± flexuous, old leaf tips usually curling, finely multi-striate, glabrous except for margins, green to brown, concolorous, keeled along mid-nerve or not, margins scaberulous, not recurved, apex long-attenuate, setaceous; lowest leaves reduced to a sheath, lamina reduced to a mucro, pale to reddish brown. *Inflorescence* very contracted, panicle-like or subcapitate and appearing head-like, straight to somewhat flexuous, with 2–6 nodes, 0.5–1.7 cm long, 6–16 mm wide, not interrupted; bracts leaf-like, greatly exceeding the spikelet clusters in length, sheaths in the lower part of the inflorescence open, not or sometimes enveloping the higher bracts, gradually reducing along the inflorescence and often mostly hidden among the spikelets, basal bract spreading to sub-erect, similar to the leaves, much longer than the inflorescence, to 65 mm long; branches erect to spreading, with 2–5 spikelets in a terminal cluster, spikelet(s) on short, terete, glabrous peduncles 0.2–1.4 mm long, arising in each bract axil; basal branchlet 4.5–6.6. mm long (including spikelets); spikelet prophyll present, sheath 0.9–1.5 mm long, brown, partially enclosing the spikelet, with a slender lamina 0.2–1.6 mm long, brown. *Spikelets* pale to dark brown or chestnut, narrow-ovate, 4.7–8 mm long, 1.2–3.2 mm wide, terete, with 5–9 glumes, only topmost 1 or 3 fertile, the lower 2 flowers when present male fertile, the upper flower bisexual, fertile, no reduced glume above the florets; glumes spirodistichous, basal glume 2.6–4.2 mm long, fertile glumes 3.8–6.2 mm long, 0.9–1.6 mm wide, membranous, pale to dark brown or chestnut, lamina puberulent or glabrous, keel and margins scaberulous, ciliate or denticulate, acute or attenuate, often sparsely scabrous on the keel, usually ciliate on the margins, lamina glabrous, ovate-lanceolate, acute to acuminate or obtuse, with a mucro 0.3–1.2 mm long, keel distinct; rachilla compact and not sinuous in fruiting spikelets. *Perianth segments* 6, whitish, minute, ± linear, flat to terete, margins with dense to scattered, white, short, antrorse, ciliate or ciliate-plumose hairs, persistent on the nutlet. *Stamens* 3; anther connective 2.0–6.2 mm long, linear to subulate; anthers yellow, 1.8–3.1 mm long, twisted when dry, with a glabrous apical appendage 0.5–0.8 mm long. *Style* trifid, base 1.4–3.5 mm long, glabrous, slender throughout, branches 1.3–2.9 mm long, hispidulous. *Nutlet* stipitate, stipe 0.3–0.5 mm long, somewhat constricted, obovoid to obpyriform, obscurely trigonous, dull, brown to dark brown, reddish brown or grey, 1.4–2.3 mm long including the stipe and style base, 1.0–1.4 mm diam., faces irregularly reticulate to rugulose or tuberculate at 40× magnification, shortly hispidulous to scabrous or tuberculate at the apex, otherwise glabrous; epidermal cells usually square–hexagonal, inconspicuous, with three fine white ribs, style base not enlarged, thin, sometimes part of the base persistent, cylindrical; embryo Schoenus-type. Photosynthetic pathway inferred from anatomy to be C_3. 1C = 0.26 pg for *C. turbinata* (*K.L. Wilson 10781*; Bureš *et al.* 2013).

Diagnostic characters: This genus is characterised by the combination of pseudobulbous bases, leaves with a well-developed lamina; a capitate or turbinate inflorescence subtended by several involucral bracts that greatly exceed the spikelets; the inflorescence branches supporting 1–3 spikelets each, the branches very short and hidden below the spikelets; a non-flexuous, straight rachilla with very short internodes; and flattened to terete, hairy perianth segments.

Distribution: Three species endemic to the southern Australia, one eastern and two western.

Etymology: A combination of the Greek words *chaete* (bristle) and *spora* (a seed), not defined by Brown (1810), but inferred to be referring to the nutlet surrounded by bristles.

Notes: A lectotype for the genus was chosen by Barrett *et al.* (2020a) while revising the genus, allowing the name to be separated from *Schoenus* and used for three species endemic to southern Australia. Descriptions and illustrations of the three species recognised are presented in Barrett *et al.* (2020a). The generic description above has been expanded from Barrett *et al.* (2020a) to be comparable to the description of *Tricostularia* presented below.

Key to species of *Chaetospora* (from Barrett *et al*. 2020a)

1. Inflorescence ± obovoid; leaf sheath 4–7 cm long (SE Australia)..***C. turbinata***

1: Inflorescence ± globose to depressed globose; leaf sheath 2–4 cm long (SW Australia) 2

2. Flower head usually black (sometimes dark brown); spikelets 1-flowered; perianth segments flat, ciliate, 1.5–2 mm long (about as long as the nutlet) ....***C. curvifolia***

2: Flower head rather pale brown; spikelets 3-flowered; perianth segments compressed to terete, 0.2–0.4 mm long (much shorter than the nutlet) ....***C. subbulbosa***

Morelotia Gaudich., *Voy. Uranie* 4(10): 416 (1829).

Type species: *Morelotia gahniiformis* Gaudich.

Tetrariopsis C.B.Clarke, *Bull. Misc. Inf., Kew – Add. Ser.* 8: 45 (1908), *syn. nov*.

Type species: *Tetrariopsis octandra* (Nees) C.B.Clarke.

[*Tetrariopsis* C.B.Clarke in L.Diels & E.Pritzel, *Bot. Jahrb. Syst., Pflanzenges. Pflanzengeog.* 35(1): 81 (1904), *nom. inval., nom. nud.*]

Perennial tufted herbs, 0.7–1.2 m high; plants clonal, 0.2–0.8 m across; rhizome thick, woody, short, branched, 5–15 mm diam., pseudobulbous or not; old leaf sheaths covering the rhizome, breaking apart into fibres with age or not, dark brown to blackish brown; roots sand-binding or not. *Culms* stout, erect, with 0, 1 3 or 4 leafy nodes, trigonous or ± terete, 1.0–5.5 mm diam., multi-striate, glabrous or rugulose. *Caudex* absent. *Leaves* mostly basal, numerous, and with 0, 1 3 or 4 cauline; phyllotaxy loosely spirotristichous, sheath glabrous or sometimes pubescent (then glabrescent), tight around culm, 8–60 mm long, 1.2–6 mm wide, ± equal in width to or broader than the leaf lamina, pale brown to dark brown to blackish brown, upper margin usually with fine, blunt scabrous projections, ligule absent; *pseudopetiole* present or not obvious; basal leaves 12–62 cm long, 2–8 mm wide, lamina ± linear, sometimes twisted or curved, finely multi-striate, glabrous or midrib scabrous, dark green, often slightly paler below, margins usually finely bluntly scabrous, sometimes revolute or involute, apex long-attenuate. *Inflorescence* open or dense, panicle-like, narrow, linear to lanceolate, 5–35 cm long, 5–35 mm wide, axis green, not glaucous; with 3–8 nodes; bracts leaf-like, becoming progressively smaller up the culm, ± equal to greatly exceeding the spikelet clusters, basal bract shorter than to exceeding inflorescence; branches erect, basal branch 2–7 cm long, with 2–20 clustered spikelets on peduncles 0.5–5 mm long, arising in each bract axil; spikelet prophyll present, sheath 1.2–4.5 mm long, brown, with 3 distinct veins, partially enclosing the spikelet, with a slender lamina 0.2–8.5 mm long, brown to green. *Spikelets* chestnut to brown, lanceolate to ovate, 6.5–15 mm long, not compressed, with 5–8, rarely 9, glumes, usually 1 or 2 fertile florets, sometimes 3, upper glume with a sterile male flower, second upper glume bisexual fertile, lower glumes empty, or rarely the third upper glume with a bisexual sterile or male-fertile flower, glumes spirodistichous, basal glume 2.5–7.8 mm long, fertile glumes 4.5–11.5 mm long, 1.6–3.5 mm wide, glabrous, scabrous or pubescent, especially on keel and towards the apex, elliptic-lanceolate, acute to acuminate, weakly keeled, with a mucro 0.4–3.0 mm long; rachilla mostly compact, but shortly sinuous around nutlet in fruiting spikelets in some species. *Perianth segments* absent or sometimes 2 or 6 segments present, 0.4–1.6 mm long, filiform, glabrous. *Stamens* usually 3, 6 or 8, rarely also 4 or 9; anther connective 4.3–9.6 mm long, linear; anthers yellow or pale yellow, 3.1–6.5 mm long, linear-oblong, base auriculate, with a glabrous or scaberulous apical appendage 0.5–2.0 mm long. *Style* usually 3-branched (but 3–5 in *M. octandra*), base 3–7.3 mm long, glabrous or finely scabrous, thin above, thin or dilated below, branches 2.5–10 mm long. *Nutlet* straw-coloured, pale brown, brown or black, sessile (or shortly stipitate in *M. microcarpa*), angular globose, strongly 3(–5)-ribbed, 2.1–5.4 mm long including the style base, 0.8–2.3 mm diam., epidermal cells square, oblong, semi-circular or hexagonal, but inconspicuous; apex sometimes with a very distinct persistent style base, depressed-ovoid, pyramidal or shortly conical, somewhat constricted at the base, scabrous-pubescent, 0.5–2.0 mm long; embryo Schoenus-type. Photosynthetic pathway inferred from anatomy to be C_3.

Diagnostic characters: Culms with 0, 1, 3 or 4 nodes below the inflorescence; caudex absent; leaf lamina well-developed, 12–62 cm long, 2–8 mm wide; involucral bracts leaf-like; inflorescence open, elongate or dense, panicle-like, 5–35 cm long, branches erect to spreading; rachilla curved around nutlet or not; perianth segments 0, 2 or 6, 0–1.5 mm long; nutlets ± sessile (or shortly stipitate in *M. microcarpa*).

Distribution: Three species endemic to the Pacific (one each in Hawai'i, French Polynesia and New Zealand), and three endemic to southern Western Australia.

Etymology: Named for French pharmacist Simon Morelot (1751–1809), author of several books on pharmacy and natural sciences.

Notes: While Clarke (1904) provided a direct reference to a published species description (Bentham 1878), this is not sufficient to validate his proposed generic name *Tetrariopsis* and therefore the new combination *Tetrariopsis octandra* is also invalid in that publication (Turland *et al.* 2018; Art. 38.11). Both the genus and new combination were subsequently validly published by Clarke (1908).

The inclusion of *Machaerina involuta*, *Tetraria australiensis*, *T. microcarpa* and *Tetrariopsis octandra* in *Morelotia* significantly increases the range of morphological diversity in the genus relative to previous treatments.

Historically, *Morelotia* has commonly been included in *Gahnia*. Spikelet prophylls are present in *Morelotia* (absent in *Gahnia*), described as 'scale-leaves' by Benl (1940a,b; 1950) and 'prophylls' by Blake (1969). These are found at the base of all ramifications of the inflorescence (including below each spikelet). Bruhl (1992, 1995) differentiated these as 'prophylls' and 'spikelet prophylls', and we follow this here. Ligules are absent in *Morelotia*, and the rachilla is elongated and curved around the nutlet (Blake 1969). Species of *Gahnia* have a leaf ligule, lack spikelet prophylls, and have a compact rachilla (Blake 1969).

Excellent diagrams of the floral structure in *Morelotia affinis* and *M. gaudichaudii* are provided by Kern (1962, fig. 1). Kern (1962) considered *Morelotia affinis and M. gaudichaudii* to belong in *Machaerina* based on the trigonous culms, revolute leaves, distichous glumes, presence of an imperfect second flower and greatly thickened style-base. This may have influenced St John's decision to describe his new species as *Machaerina involuta* (St John 1984), but no notes to this effect have been found. Blake (1969) pointed out that *Machaerina* differs significantly from *Morelotia* as *Machaerina* lacks trigonous culms, dorsiventral, revolute leaves, and distichous, deciduous glumes, and has a compact rachilla.

Key to species of *Morelotia*

1. Culms rugulose-asperulous on faces, scabrid on angles; inflorescence subspiciform, with 12–20 spikelets per branchlet; spikelets 3.5–4 mm long, with 3 fertile flowers; basal glume 1.2–2.2 mm long, fertile glumes 2.6–3.4 mm long, 0.7–0.9 mm wide; anthers 0.8–0.9 mm long, connective 1.8–2.5 mm long; style 3.1–3.8 mm long; nutlets 1.4–1.7 mm long (SW Australia)........ ***M. microcarpa***

1: Culms glabrous; inflorescence open or dense, panicle-like, with 2–15 spikelets per branchlet; spikelets 6.5–15 mm long, with 1 or 2 fertile flowers; basal glume 2.5–7.8 mm long, fertile glumes 4.5–11.5 mm long, 1.6–3.4 mm wide; anthers 3.1–6.5 mm long, connective 4.3–9.6 mm long; style 7–15 mm long; nutlets 2.1–5.4 mm long........ 2

2. Ramets at least somewhat pseudobulbous; roots sand-binding; leaf sheaths clasping the culms; leaf lamina flat, channelled or revolute; basal glume 5.0–7.8 mm long; upper flower bisexual fertile; stamens 6 or 8; style 5–7.3 mm long; nutlets 4.5–5.4 mm long, apex scabrous or hispidulous........ 3

2: Ramets not pseudobulbous; roots not sand-binding; leaf sheaths loose on the culms; leaf lamina flat, becoming involute and often appearing terete with age; basal glume 2.5–4.1 mm long; upper flower infertile; stamens 3; style 3–5.1 mm long; nutlets 2.1–3 mm long, apex glabrous........ 4

3. Culms with 3 or 4 nodes below the inflorescence; leaf sheath pubescent (at least when young); leaf lamina 12–18 mm long; spikelets 8–10 mm long; 5 glabrous glumes; rachilla compact; and usually 6 anthers (SW Australia)........ ***M. australiensis***

3: Culms with 0 or 1 nodes below the inflorescence; leaf sheath glabrous; leaf lamina 15–60 cm long; spikelets 10–15 mm long; 7–9 scabrous to pubescent glumes; rachilla curved around the nutlet; and usually 8 anthers (SW Australia)........ ***M. octandra***

4. Culms always with a single node below the inflorescence; 1.3–1.7 mm broad; basal leaves 2.5–4 mm wide, involute, appearing 1–1.3 mm wide, margins very finely scabrous, usually recurved when dry; inflorescence branches 20–25 mm long, with (1)2 or 3 clustered spikelets; perianth segments present, filiform, 0.4–1.1 mm long; nutlet mostly stramineous but apex brown (Rapa Iti, French Polynesia)........ ***M. involuta***

4: Culms variously with 0–4 nodes below the inflorescence; 1.5–3.8 mm broad; basal leaves 2–8 mm wide, involute, appearing 1.5–2.5 mm wide, margins harshly scabrous, usually strongly revolute when dry; inflorescence branches 20–70 mm long, with 2–15 clustered spikelets; perianth segments absent; nutlet lustrous red-brown to black, apex black........ 5

5. Leaves rapidly and completely revolute; leaf sheath 35–60 mm long; leaf lamina midrib hairy; spikelets reddish brown; basal glume 2.4–2.8 mm long; fertile glumes puberulent; nutlet apex subconical, epidermal cells semi-circular to hexagonal (New Zealand)........ ***M. affinis***

5: Leaves slowly and usually incompletely revolute; leaf sheath 25–39 mm long; leaf lamina midrib glabrous; spikelets brown; basal glume 3.8–4.1 mm long; fertile glumes hispidulous; nutlet apex obtuse-apiculate, epidermal cells oblong to square–hexagonal (Hawaii) .... ***M. gahniiformis***

Morelotia affinis (Brongn.) S.T.Blake, *Contr. Queensland Herb*. 8: 38 (1969). *Lampocarya affinis* Brongn. in L.I.Duperrey, *Voy. Monde, Phan*. (part 11); 166–167, t. 29, figs 1–4 (1833). *Schoenus arenarius* Banks & Sol. ex Hook.f., *Fl. Nov. Zel.* 1: 277 (1853), *nom. illeg*., *in syn*., *non* Schrad. (1832). *Gahnia affinis* (Brongn.) Steud., *Syn. Pl. Glumac*. 2: 164 (1855). *Gahnia arenaria* Hook.f., *Handb. N. Zeal. Fl.* 1: 306 (1864), *nom. illeg. Mariscus affinis* (Brongn.) Kuntze, *Revis. Gen. Pl.* 2: 755 (1891). *Machaerina affinis* (Brongn.) J.Kern, *Acta Bot. Neerl.* 11: 223 (1962).

Type citation: 'Nouvelle-Zélande.'

Type: New Zealand: Voy. Astrolabe, [1827], *J.S.C.D. d'Urville s.n*. (lectotype (here designated): P 00601899* [excluding fruit of *M. gaudichaudii* in packet]; probable isolecto: P 01869436*).

Morelotia gahniiformis var. *minor* A.Rich., *Fl. Nuov. Zel.* 115 (1832).

Type citation: 'Crescit in Novae-Zeelandiae loco dicto *baie des Iles*. (v. s. s.)'

Type: New Zealand: Baie des Iles [Bay of Islands], [Mar. 1827] Voy. Astrolabe, [*J.S.C.D. d'Urville & R-P. Lesson*] *No. 39* (lectotype (here designated): P 01869439*).

Residual syntypes: New Zealand: Baie des Iles [Bay of Islands], Voy. Astrolabe, [*J.S.C.D. d'Urville & R-P. Lesson s.n.*] P 01869438*, P 01869440*; [*J.S.C.D. d'Urville & R-P. Lesson No. 28*] P 01869441*).

Cladium quadrangulare Nees, *Linnaea* 9: 301 (1834), *nom. inval., nom. nud*.

Illustrations: Illustration on sheet: P 01869438. Brongniart in Duperrey (1833, t. 29, figs 1–4; reproduced by St John 1958 as fig. 1, No. 1–4); Kern (1962, fig. 1: 8–11).

Perennial tufted *herb*, 0.2–0.7 m high; plants presumably clonal, 0.4–1 m across; rhizome thick, woody, short, branched, 5–10 mm diam., pseudobulbous; old leaf sheaths covering the rhizome, breaking apart into fibres and the leaf base becoming twisted with age, cream to pale brown; roots not sand-binding. *Culms* stout, erect, with 0–2(–4) leafy nodes, trigonous, 1.9–3.5 mm broad, smooth, glabrous, base not enlarged. *Leaves* mostly basal, numerous, and 0–2(–4) cauline; phyllotaxy loosely spirotristichous, sheath striate, margin finely scabrous, otherwise glabrous, open, 35–60 mm long, 4–6 mm wide, broader than the leaf lamina, cream, upper margin membranous, ligule absent; basal leaves 20–62 cm long, 4–8 mm wide, but becoming involute and appearing filiform and 1.5–2.1 mm wide with age, lamina dorsiventral, ± linear, curved, finely multi-striate, scabrid below, especially on midrib, green to yellow-green (rarely dark green), slightly paler below, margins harshly scabrous, strongly revolute when dry, apex gradually attenuate and curled when dry; cauline leaf lamina 15–20 cm long. *Inflorescence* dense, panicle-like, narrow, linear, 5–30 cm long, 15–35 mm wide, with 5–8 fertile nodes; axis green; bracts leaf-like, rigid, scabrid, with pale brown sheaths 10–35 mm long, becoming progressively smaller up the culm, greatly exceeding the spikelet clusters, basal bract ± equal to inflorescence; branches 20–70 mm long, erect, with 3–15 clustered spikelets on peduncles 0.5–1 mm long, arising in each bract axil; spikelet prophyll present, sheath indistinct, lamina 1.4–1.6 mm long, brown, with 1 distinct vein. *Spikelets* reddish brown, narrow-lanceolate to ovate-lanceolate, 6.5–10 mm long, 1.4–2.2 mm diam., ascending, not compressed, with usually 7 glumes, the topmost infertile, subtended by a minute membranous glume, upper 2 larger glumes each subtending a flower, enclosed by the wing of the next glume, lower flower bisexual, upper functionally male, lower glumes empty, glumes distichous (basal glumes somewhat twisting with age so can appear spirodistichous), somewhat compressed, coriaceous, lower glumes caducous, basal glume 2.4–2.8 mm long, fertile glumes 4.5–9 mm long, 1.8–3.4 mm wide, minutely puberulous, lanceolate, acuminate to acute, keeled, the keel and margins finely scabrid, sometimes with a mucro to 0.4 mm long; rachilla compact, but the uppermost internode elongated and curved in fruiting spikelets. *Perianth segments* absent. *Stamens* 3; anther connective 6.3–8.8 mm long, elongating further after anthesis, linear, persistent at base of nutlet, distal portion held within the convolute apex of subtending glume, so mature nutlets pendent on the inflorescence post-release; anthers yellow, 3.6–4.2 mm long, linear-oblong, base auriculate, with a glabrous apical appendage up to 1.4 mm long. *Style* 3-fid, base 3.9–4.2 mm long, hispidulous, thin throughout, branches 3.1–3.7 mm long, hispidulous-papillose. *Nutlet* sessile, elliptic-obloid, subterete but somewhat trigonous, with 3 longitudinal ribs, lustrous red-brown to black, apex black and subconical, smooth, 2.5–3.0 mm long including the style base, *c*. 1.5 mm diam., mesocarp crustaceous, epidermal cells semi-circular–hexagonal, conspicuous; style base thickened, somewhat corky, persistent, very distinct in the immature fruit, less distinct at maturity, glabrous, *c*. 0.9 mm long; embryo not examined. Photosynthetic pathway inferred from anatomy to be C_3 (*Bagnall s.n.*, CHR 56270; Bruhl & Wilson 2007). $2n = 46$ (de Lange *et al*. 2004). (Figure 6).

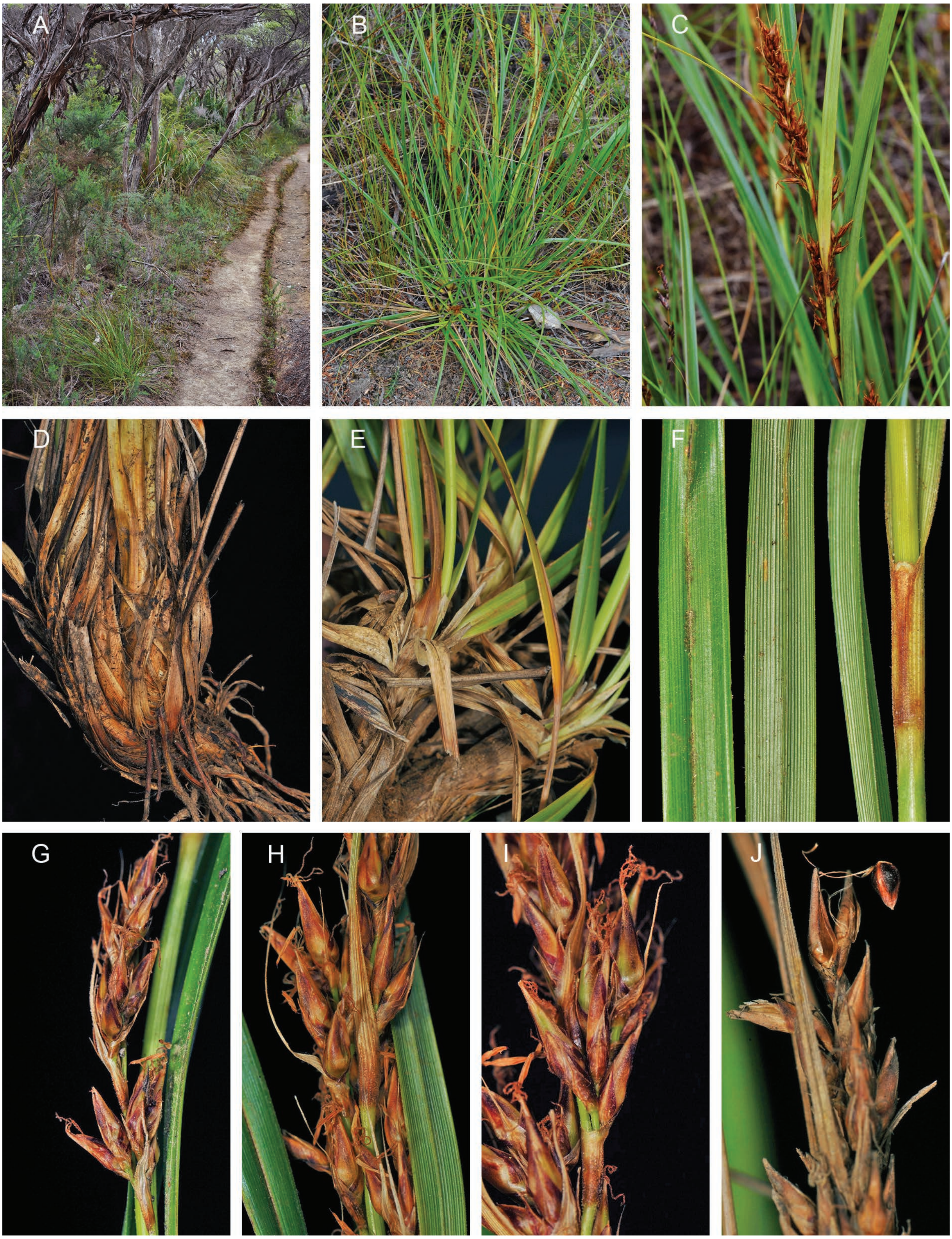

Fig. 6. *Morelotia affinis*. Whatipu, North Island, New Zealand. A. Habitat. B. Habit. C. Inflorescence. D. Plant base and roots. E. Plant base and leaf rosette. F. Leaf above (left), leaf below (2 central), cauline leaf sheath (right). G, H. Spikelets with old stamens. I. Spikelets with old styles. J. Spikelets with mature nutlet held by persistent anther filaments. Vouchers, A–D, F, G, I from *J.J. Bruhl 2923* (NE); E, H, J from *J.J. Bruhl 2924* (NE). Photos by J.J. Bruhl.

Diagnostic characters: Differs from *M. gahniiformis* in the leaves being more rapidly and completely revolute; leaf sheath 35–60 mm long (*vs* 25–39); leaf lamina midrib hairy (*vs* glabrous); spikelets reddish brown (*vs* brown); basal glume 2.4–2.8 mm long (*vs* 3.8–4.1); fertile glumes puberulent (*vs* hispidulous); the nutlet apex subconical (*vs* obtuse-apiculate), epidermal cells semi-circular–hexagonal (*vs* oblong–square–hexagonal).

Distribution: Endemic to New Zealand, widespread on the North Island, but rare on the South Island, with records near Nelson and Christchurch (Edgar 1970).

Habitat: Grows in a wide range of coastal to montane habitats with a variety of soils and geologies, but usually on steep clay banks, cliff faces and hillsides, and known to readily colonise steep rock faces and boulder falls. Recorded in gumland scrub, Kauri forest, Manuka forest and shrublands in association with *Acaena pallida*, *Apodasmia similis*, *Astelia banksii*, *A. trinervia*, *Carex appressa*, *C. geminata*, *C. fascicularis*, *C. flagellifera*, *C. forsteri*, *C. healyi*, *C. minor*, *C. pumila*, *C. punctata*, *C. uncinata*, *Celmisia major*, *Coprosma baueri*, *C. microcarpa*, *Cordyline* spp., *Cyperus ustulatus*, *Eleocharis neozealandica*, *Epacris pauciflora*, *Euphrasia cuneata*, *Ficinia spiralis*, *Gahnia pauciflora*, *G. setifolia*, *Geranium homeanum*, *Gleichenia microphylla*, *Isolepis cernua*, *Knightia excelsa*, *Lepidosperma australe*, *Leptospermum scoparium*, *Leucopogon fasciculatus*, *L. fraseri*, *Lycopodium* spp., *Machaerina rubiginosa*, *Meterosideros exselsa*, *Myrsine australis*, *Ozothamnus leptophyllus*, *Phyllocladus* spp., *Pittosporum eugenioides*, *Pomaderris rugosa*, *Schoenus tendo* and *Veronica obtusata*.

Phenology: Flowers recorded for October–December. Fruiting recorded for (October–)November–April, but old inflorescences are persistent.

Selected specimens examined: NEW ZEALAND: [island not specified]: 1854, *W. Hooker s.n.* (P*); 'New South Wales' [New Zealand], 1838–1842, *Wilkes Expedition* (US*). NORTH ISLAND: Mahina Bay, 26 Aug. 1941, *G. Bagnell s.n.* (CHR 56270, *n.v.*, NSW); near Tolaga, Opuragi, Oouhuragi, 1769, *J. Banks & D.C. Solander s.n.* (AK 109793*, BM 000991155*, US 02234605*, WELT SP063907*); Waitakere Ranges, Kaitarakihi Park, site of Nov 1983 burn, 6 Nov. 1987, *R.E. Beaver s.n.* (AK 156546*); Waitakere Ranges Regional Parkland, 1.4 km N of Whatipu Lodge, along walking track, 5 Dec. 2010, *J.J. Bruhl 2923* (NE); Motukino (Fanal) Island, W side. Taranga Ecological District, 21 Sept. 1994, *E.K. Cameron & P.J. de Lange 7788* (AK, *n.v.*, HO); Parahaki, Oct. 1898, *H. Carse s.n.* (AK 214665*); near Tirau (Oxford), Oct. 1896, *T.F. Cheeseman s.n.* (AK 214664*); Mangorewa River, Tauranga County, 15 Oct. 1965, *R.C. Cooper s.n.* (AK, *n.v.*, NSW); North Auckland, Kaukapakapa Gumlands, 28 Jan 1961, *A.E. Esler s.n.* (AK 363112*); Auckland, 1875, *M. Filhol 860* (P*); hills south of Piha, West Coast, west of Auckland, 4 Feb. 1949, *F.R. Fosberg 30221* (US*); 3.3 km S of Ahipara, Ahipara Gumfields Historic Reserve, 17 July 1990, 30 Apr. 1990, *J. Fox s.n.* (AK 374668*, WELT, *n.v.*); Craigavon Park, Auckland, 3 Mar. 1974, *R.O. Gardner 864* (AK, *n.v.*, CBG); Waitakere Ranges, 1942, *E.T. Giles s.n.* (NE 21620); [Lake] Taupo, 1873, *Gohenacker s.n.* (P*); Te Paki, North Cape Peninsula, Surville Cliffs, 19 Oct. 2009, *P.J. de Lange 8023* (AK, *n.v.*, CHR, *n.v.*, NSW, WELT, *n.v.*); Days Bay, Eastbourne, Wellington, 4 Oct. 1948, *R. Mason s.n.* (CHR, *n.v.*, NSW); Auckland, Sept. 1929, *A. Meebold 5346* (US*); Shag Track, Little Barrier Island, 7 Mar. 1962, *R. Melville & W.M. Hamilton 6614* (K, NSW); road between Paengoroa and Lake Rotaiti, 27 Oct. 1964, *C.C. Ogle s.n.* (WELT SP106926*); North Cape Peninsula, 25 Nov. 1916, *R.B. Oliver s.n.* (WELT SP010160*); Auckland, early Nov. 1911, *D. Petrie s.n.* (AK, *n.v.*, NSW); Auckland, 1850–1860, *A. Sinclair s.n.* (NSW); Wellington, Jan. 1909, *H.H. Travers s.n.* [*?221*] (P*); Kawakawa [Bay], *J.S.C.D. d'Urville 333* (P, 3 sheets*); Koangata, [rec. 1824], *J.S.C.D. d'Urville s.n.* (P*); near Babylon, south of Kaihu, 8 Apr. 1947, *E.H. Walker 5268* (US*). SOUTH ISLAND: Akaroa, *St. Croix de Belligny s.n.* (P*).

Conservation: Relatively widespread on the North Island of New Zealand, occurring in numerous nature reserves, and listed as Not Threatened (de Lange *et al*. 2018). IUCN: Least Concern.

Etymology: From the Latin *affinis* (near), possibly referring to the similarities of this species to *Lampocarya gaudichaudii* Brongn. (=*Morelotia gahniiformis*), but the original intent is not known.

Notes: The lectotype of *Lampocarya affinis* is chosen as it is the only sheet at P bearing a label '*Lampocarya affinis* Brongn. nov. spec.' As noted by St John (1958), there are several fruit of *M. gahniiformis* in a packet on the lectotype sheet (but excluded above), presumably those used for the illustration in t. XXIX, fig. 5 (Brongniart in Duperrey 1833). Fruit were evidently removed previously from both sheets of both species for illustration, and presumably returned to the wrong sheet by mistake as the same error has occurred on a type sheet of *M. gahniiformis*. These fruit are therefore specifically excluded from the type statement above.

Both P 01869439 and P 01869441 are from Richard's herbarium, and are suitable for selection as lectotype of *Morelotia gahniiformis* Gaudich. var. *minor* A.Rich. Neither sheet has been annotated with the varietal name. P 01869439 is selected as there is more material on the sheet. Richard (1832) provided extensive notes on the differences between the Hawaiian and New Zealand *Morelotia* specimens, but conservatively only separated them at varietal level.

The invalid name *Cladium quadrangulare* Nees was published without any description and can only be assigned based on specimen annotations. The sheet P 01869420 is annotated with this name, and belongs to *G. affinis*, not *M. gahniiformis* where it is traditionally included. Heller (1896) noted that Nees (1834) separated this taxon from *M. gahniiformis*, supporting the idea that it more likely applies to the taxon now recognised as *G. affinis*.

Seed is noted to be difficult to germinate and probably exhibits physical dormancy (New Zealand Plant Conservation Network 2020).

Moar and Wilmshurst (2003) report that the pollen grains of *M. affinis* are similar to those of *Gahnia procera* J.R.Forst. & G.Forst. and *G. xanthocarpa* Hook.f. (*Gahnia*-type).

Morelotia australiensis (C.B.Clarke) R.L.Barrett & K.L.Wilson, ***comb. nov.***

Basionym: *Tetraria australiensis* C.B.Clarke in L.Diels & E.Pritzel, *Bot. Jahrb. Syst., Pflanzenges. Pflanzengeog.* 35(1): 80–81, fig. 5g–q (1904).

Type citation: 'Hab. in distr. Darling pr. Serpentine Riv. in silvis apertis arenosis subhumosis flor. m. Decembr. (E. Pritzel Plant. Austr. occ. 138; D. 1872).'

Type: Serpentine River, Western Australia, 1900, *F.L.E. Diels 1872* (lectotype (here designated): K 000960103 (ex B); isolecto: PERTH 01049585 (fragment)).

Residual syntype: Murray District, Western Australia, Dec. 1900, *E. Pritzel* [*Plant. Austr. Occid. 138*] (syn: BM 000798892, E 00688600, G 00195291, G 00195292, K 000960104, L 0042803, NSW 687847).

Illustrations: Clarke in Diels & Pritzel (1904: 82, fig. 5g–q); Wheeler & Graham (2002: fig., p. 297); Brown *et al*. (2008: pl., p. 150).

Perennial (short-lived) tufted herb, 0.3–1.3 m high; plants clonal, 0.1–0.6 m across; rhizome short, thick, woody, 8–15 mm diam., not pseudobulbous; old leaf sheaths covering the rhizome, not breaking apart into fibres with age, dark brown to blackish brown; roots sand-binding. *Culms* stout, erect, with 3 or 4 distant, leafy nodes, ± terete, 2.0–5.5 mm diam., multi-striate, glabrous, base not or slightly enlarged. *Leaves* mostly basal, numerous, and 3 or 4 cauline, reducing in size up the culm, ultimately bract-like; phyllotaxy loosely spirotristichous, sheath pubescent (?glabrescent), tight around culm, 20–45 mm long, 3–6 mm wide, ±equal width to the leaf lamina, dark brown to blackish brown, upper margin glabrous, ligule absent; basal leaves 12–18 cm long, 2–6 mm wide, lamina ±linear, channelled to ± flat, finely multi-striate, pubescent when young, green to blue-green, paler below, margins sparsely scabrous, sometimes recurved, apex long-attenuate. *Inflorescence* open, panicle-like, narrow, ± linear, 15–27 cm long, 10–20 mm wide, axis blue-green, yellow-green or pinkish brown, slightly glaucous; bracts leaf-like, shorter than to slightly exceeding the spikelet clusters, basal bract much shorter than inflorescence; branches erect, with 3–10 densely clustered spikelets on short peduncles 1–2 mm long, arising in each bract axil; spikelet prophyll subtending each spikelet glume-like, sheath 3.7–4.1 mm long, pale brown, with 1 indistinct vein, partially enclosing the spikelet, without a lamina. *Spikelets* pale brown (apex of glumes reddish when young), very narrow-ovoid, 8–10 mm long, laterally compressed, with usually 5 glumes, glabrous but cell surface raised so appears very finely papillose at 20× magnification, only topmost 2 fertile, the lower flower bisexual but often reduced and infertile, the upper flower bisexual, fertile, lower glume 6–7 mm long, fertile glumes 7–9 mm long, 1.6–2.1 mm wide, glabrous, acute to obtuse with a mucro to 1.5 mm long; rachilla compact and not sinuous in fruiting spikelets. *Perianth segments* absent. *Stamens* (3)6 in upper flower, 6 in lower flower; anther connective 5–7 mm long, linear; anthers yellow, 5.5–6.5 mm long, with a scaberulous apical appendage up to 1 mm long. *Style* trifid, base 5–7 mm long, not dilated, glabrous, branches 2.5–3.0 mm long. *Nutlet* sessile, ovoid to ellipsoid, 4.9–5.4 mm long, 2.0–2.3 mm diam., smooth, epidermal cells square–hexagonal, inconspicuous, with 4 or 5 distinctly raised white ribs that broaden and fuse with the apex, apex with a very distinct persistent style base, broadly subconical to pyramidal, somewhat constricted at the base, to 1.4 mm long, finely hispidulous; embryo not examined. Photosynthetic pathway not examined. 1C = 0.49 pg (*BGPA 20100981*; Bureš *et al*. 2013). (Figure 7).

Diagnostic characters: Differs from *Morelotia octandra* in its 3 or 4 (*vs* 0 or 1) nodes below the inflorescence; pubescent (at least when young) (*vs* glabrous) leaf sheath; leaf lamina 12–18 (*vs* 15–60) cm long; spikelets 8–10 (*vs* 10–15) mm long; 5 glabrous (*vs* 7–9 scabrous to pubescent) glumes; rachilla compact (*vs* curved around the nutlet); and usually 6 (*vs* usually 8) anthers.

Distribution: Apparently endemic to the greater Perth region, occurring on the eastern side of the Swan Coastal Plain, from Busselton, Mundijong and Waroona, north to Serpentine. Historical populations near the Perth suburbs of Armadale and Canning are apparently now extinct.

Habitat: Usually in winter-wet swampy depressions, drainage lines or sandy rises adjacent swamps, growing in grey sand over clay or yellow and sandy or clayey lateritic soils. In open *Corymbia calophylla* or *Eucalyptus marginata* woodland over low shrubs, herbs and sedges in association with *Anigozanthos* *humilis*, *Banksia attenuata*, *B. aurantia*, *B. menziesii*, *Conostylis setigera*, *Cyathochaeta avenacea*, *Eremaea pauciflora*, *Haemodorum* sp., *Hakea ruscifolia*, *H. cyclocarpa*, *Isolepis marginata*, *Kingia australis*, *Lechenaultia biloba*, *Lepidosperma carphoides*, *Melaleuca* sp., *Mesomelaena tetragona*, *Pericalymma ellipticum*, *Schoenus asperocarpus*, *S. lanatus*, *S. rodwayanus*, *S. subbarbatus*, *Morelotia octandra* and *Xanthorrhoea preissii*.

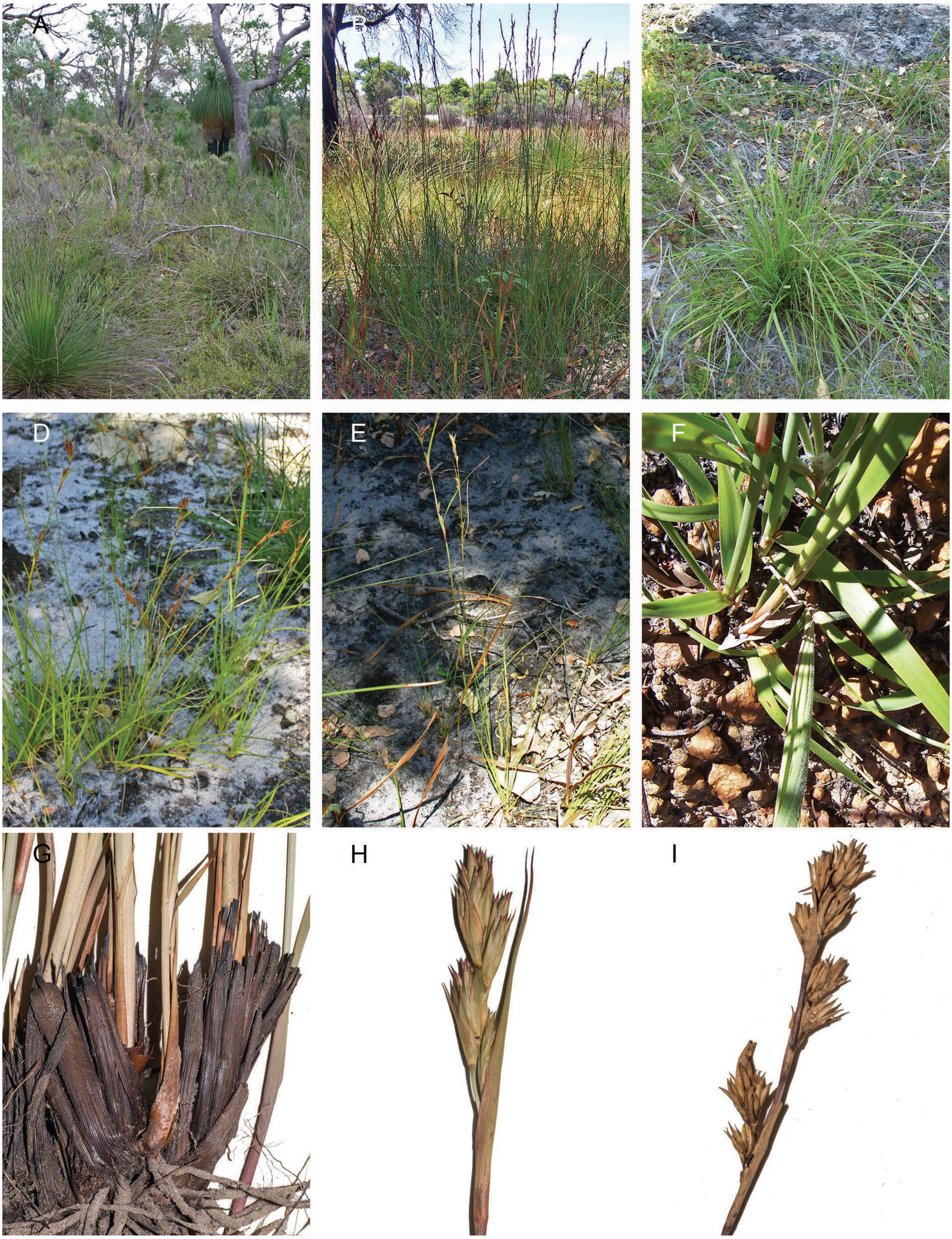

Fig. 7. *Morelotia australiensis*. A. Habitat. B. Plants in habitat. C. Plant with old inflorescences. D, E. Flowering plants. F. Leaf and culm bases. G. Plant base with new growth after fire. H, I. Inflorescence. A–E, G–I from Watkins Reserve. F from North Dandalup. G–I from *K.L. Wilson 9310* (NSW). Photos A, B, D–F by M. Okely; C. by V. English; G–I by R.L. Barrett.

Phenology: Flowers recorded for October–February, usually one year post-fire. Fruit recorded for January, February, June and October.

Selected specimens examined: WESTERN AUSTRALIA: [localities withheld] Dec. 1898, *R. Helms s.n.* (NSW 75057); Feb. 2010, *M. Hoskins & F. Felton MH 30* (PERTH); Nov. 1995, *B.J. Keighery 2270* (NSW, PERTH); Feb. 1996, *B.J. Keighery 2365a* (PERTH); Feb. 1996, *B.J. Keighery 2384* (PERTH); Feb. 1996, *B.J. Keighery 2385* (NSW, PERTH); Jan. 1993, *G.J. Keighery 12792* (CANB, MEL, PERTH); Jan. 1996, *G.J. Keighery 14348* (CANB, PERTH); June 2008, *G.J. Keighery & B.J. Keighery 1293* (PERTH); Dec. 1900, *A. Morrison s.n.* (NSW 687848); Nov. 1877, *F. Mueller s.n.* (MEL 0098630); Nov. 1994, *K.L. Wilson, K. Frank, G.J. Keighery & N. Gibson KLW 8895* (NSW, PERTH); May 1995, *K.L. Wilson 9310* (NE, NSW).

Conservation: Conservation status for Western Australian Flora: Declared Rare Flora (Vulnerable); previously believed to be extinct until rediscoved in 1993, (Hopper 1990; Keighery 1993; Brown *et al.* 2008). Twelve populations contain around 1,500 individuals, though fluctuating greatly between fire events. Three populations occur in nature reserves, while nine populations are in state forest or on private land (Department of Environment 2020).

Notes: The lectotype is chosen as it is the only sheet at K annotated with the name *Tetraria australiensis* by Clarke. It is also accompanied by an illustration of a dissected spikelet. While the sheet at K originated at B, no duplicate has been located there and the original B specimen has probably been destroyed.

Tetraria australiensis is sometimes listed as validated by C.B.Clarke in *Bull. Misc. Inform. Kew, Addit. Ser.* 8: 48 (1908), but the name was validly published by Clarke (1904).

Considered to be a fire ephemeral, short-lived and fire-dependant (Evans *et al.* 2003). However, this species can resprout following fire, so it may survive longer than currently thought, as might be expected for a clonal species, but not flower and thus be difficult to locate (Keighery 1993). Monitoring of individuals is required to determine plant longevity.

This species has the common names of Southern Tetraria and Leafy Sedge.

Morelotia gahniiformis Gaudich., *Voy. Uranie Bot.* 4(part 10): 416 (1829), (as *M. gahniæformis*). *Lampocarya gaudichaudii* Brongn. in L.I.Duperrey, *Voy. Monde, Phan.* 2: 166–167, pl. 29 (1833), *nom. illeg. Gahnia gaudichaudii* (Brongn.) Steud., *Syn. Pl. Glumac.* 2: 164 (1855). *Mariscus gaudichaudii* (Brongn.) Kuntze, *Revis. Gen. Pl.* 2: 755 (1891). *Gahnia gahniiformis* (Gaudich.) A.Heller, *Minnesota Bot. Stud.* 1: 802 (1896). *Machaerina gahniiformis* (Gaudich.) J.Kern, *Acta Bot. Neerl.* 11: 223 (1962).

Morelotia gahniiformis Gaudich., *Voy. Uranie, Atlas* (part 4); 4, t. 28 (1827), *nom. inval.*

Type citation: 'In Insulis Sandwicensibus (alt. 450–500 hexap.).'

Type: Hawaii: Iles Sandwich, ouki incolarum, Voy. Uranie, [1819], *C. Gaudichaud-Beaupré s.n.* (lectotype, designated by St John, *Webbia* 13: 334 (1958) as 'holotype': P 00601900*; isolectotypes: G-DC, *n.v.*, K 000881763*, P 00601901*, P 00601902*).

Lamprocarya gaudichii Kunth ex H.Pfeiffer, *Fedde Repert. Sp. Nov.* 23: 349 (1927), *orth. var.*

Gahnia gahniiformis var. *elongata* Kük., *Rep. Nov. Reg. Veg.* 52: 88 (1943).

Type: Hawaii: In volcano Kilauea, May 1909, *U.J. Faurie* 1250 (lectotype, designated by St John, *Webbia* 13: 334 (1958) as 'holotype' B 10 0296673*; isolecto: BM 000991156, P 01727876*, P 01869415*, P 01869423*).

Illustrations: Gaudichaud-Beaupré (1827, t. 28); Brongniart in Duperrey (1833, pl. 29, fig. 5; reproduced by St John 1958 as fig. 1, no. 5); Benl (1937: fig. 6); Benl (1940a: fig. 6); Kern (1962, fig. 1: 1–7); Vanhecke (1974: fig. 57, p. 398); Koyama (1999, pl. 207).

Perennial tufted *herb*, (0.1–)0.2–0.7 m high; plants presumably clonal, 0.3–0.6 m across; rhizome thick, woody, short, branched, 5–8 mm diam., somewhat pseudobulbous; old leaf sheaths covering the rhizome, breaking apart into fibres, usually not twisted at the base with age, pale brown; roots not sand-binding. *Culms* stout, erect, with 1–3 leafy nodes, obtusely trigonous, 1.5–3.8 mm diam., smooth, glabrous, base not enlarged. *Leaves* mostly basal, numerous, and 1–3 cauline; phyllotaxy loosely spirotristichous, sheath margins finely ciliate-scabrous, otherwise glabrous, open, 25–39 mm long, 4–6 mm wide, broader than the leaf lamina, brown or yellowish brown, upper margin membranous, ligule absent; basal leaves 15–45 cm long, 2–8 mm wide, but commonly involute and appearing 1–2.5 mm wide, lamina dorsiventral, ± linear, curved, finely multi-striate, not scabrid below on midrib, green to yellow-green, slightly paler below, margins scabrous, usually strongly revolute, apex gradually attenuate and curled when dry; cauline leaf lamina 16–28 cm long. *Inflorescence* dense, panicle-like, narrow, linear, (5–)10–35 cm long, 10–25 mm wide, with 3–7 fertile nodes; axis green; bracts leaf-like, rigid, margins scabrid, with pale brown sheaths 10–25(–40) mm long, becoming progressively smaller up the culm, exceeding the spikelet clusters, basal bract usually longer than inflorescence; branches 35–65 mm long, erect, solitary in lower part of inflorescence, the upper ones in groups of 2–4, arising in each bract axil, mostly enclosed in the bract sheath; spikelets on peduncles 0.5–2 mm long; spikelet prophyll present, sheath indistinct, lamina 2.1–2.5 mm long, brown, with 1 distinct vein. *Spikelets* in groups of 2–8, brown, narrow-ovoid, 8–10 mm long, 2–3 mm diam., acuminate, ascending, not compressed, with 6–8 glumes, the topmost infertile, subtended by a minute membranous glume, upper 2 larger glumes each subtending a flower, enclosed by the wing of the next glume, lower flower fertile, bisexual, upper male, reduced and sterile, lower 4–6 glumes empty, glumes distichous, chartaceous, lower glumes caducous, lowest glume 3.8–4.1 mm long, upper glumes 5.6–9.9 mm long, 1.8–3.4 mm wide, hispidulous in upper part, narrowly ovate, acuminate to acute, keeled, with a mucro to 1.5 mm long; rachilla compact, but the uppermost internode elongated and curved in fruiting spikelets. *Perianth segments* absent. *Stamens* 3; anther connective 4.3–9.6 mm long, elongating further after anthesis, linear, persistent at base of nutlet, distal portion held within the convolute apex of subtending glume, so mature nutlets pendent on the inflorescence post-release; anthers yellow, 3.1–4.2 mm long, linear-oblong, base auriculate, with a minutely scabrous apical appendage up to 0.5 mm long. *Style* 3-fid, base 4.6–5.1 mm long, hispidulous, thin throughout, branches 2.5–2.9 mm long, hispidulous. *Nutlet* sessile, ovoid ellipsoid to ellipsoid, subterete but somewhat trigonous, with 3 longitudinal indentations, maturing black, slightly glossy, apex black, not constricted, smooth, 2.7–3.0 mm long including the style base, *c.* 2 mm diam., mesocarp not crustaceous, epidermal cells oblong–square–hexagonal, inconspicuous; style base trigonous-pyramidal, thickened, not corky, persistent, very distinct and cream when immature, indistinct and black when mature, glabrous, *c.* 0.7 mm long; embryo Schoenus-type. Photosynthetic pathway inferred from anatomy to be C_3 (*Henrickson 3490*; *Ordoney, 14 Jul 1940*; Bruhl & Wilson 2007). (Figure 8).

Diagnostic characters: Differs from *M. affinis* in the leaves being more gradually and incompletely revolute; leaf sheath 25–39 (*vs* 35–60) mm long; leaf lamina midrib glabrous (*vs* hairy); spikelets brown (*vs* reddish brown); basal glume 3.8–4.1 (*vs* 2.4–2.8) mm long; fertile glumes hispidulous (*vs* puberulent); the nutlet apex obtuse-apiculate (*vs* subconical), epidermal cells oblong–square–hexagonal (*vs* semi-circular–hexagonal).

Distribution: Endemic to the Hawaiian Islands, present on Kauai, Molokai, Lanai, Maui and Hawaii (Koyama 1990, 1999).

Also reported from Oahu by Kükenthal (1943) based on collections by Macrae and the Wilkes Expedition, but specimens matching the citations have not been located. The lack of recent collections suggests it may now be extinct on Oahu if it was ever present there, but it is more likely that the cited collections were not actually from Oahu, though the Mount Ka'ala is on Oahu, and botanical specimens were collected there by the Wilkes expedition, so the specimen cited would have to have been collected on either Kauai or Hawaii and erroneously labelled. An alternative possibility is that the specimens were in poor condition and thus confused with a species such as *Gahnia beecheyi* H.Mann.

Habitat: Grows on consolidated lava fields, in dry or mesic forest, in lehua-uluhe forest, subalpine shrubland, in bog-like habitats, on steep slopes, and on windswept ridges, at altitudes of 520–2,380 m. Recorded in association with *Antidesma platyphyllum*, *Astelia menziesiana*, *Broussaisia arguta*, *Carex wahuensis*, *Cheirodendron* spp., *Coprosma ernodeoides*, *Deschampsia nubigena*, *Dicranopteris linearis*, *Diospyros sandwicensis*, *Dodonaea viscosa*, *Dubautia dolosa*, *D. menziesii*, *D. platyphylla*, *D. reticulata*, *D. scabra*, *Eragrostis monticola*, *E. variabilis*, *Euphorbia sparsiflora*, *E. remyi*, *Geranium arboreum*, *Kadua* spp., *Lobelia kauaensis*, *Lysimachia hillebrandii*, *L. reayi*, *Lythrum maritimum*, *Machaerina angustifolia*, *M. mariscoides*, *Melicope* spp., *Meterosideros polymorpha*, *M. waialealae*, *Myrsine* spp., *Pelea feddei*, *P. waialealae*, *Perrottetia sandwicensis*, *Polypodium pellucidum*, *Psychotria* spp., *Racomitrium* spp., *Rhynchospora chinensis*, *Rubus niveus*, *Scaevola gaudichaudiana*, *Sophora chrysophylla*, *Sphenomeris chinensis*, *Sticherus owhyhensis*, *Styphelia tameiameiae*, *Tetramolopium capillare*, *Tetraplasandra* spp., *Vaccinium dentatum* and *V. reticulatum*.

Phenology: Flowering possibly bimodal, recorded mainly for June–September and December–January, but apparently sporadic all year round. Fruit mainly recorded for April–June and October–December.

Fig. 8. *Morelotia gahniiformis*. Maui, Hawai'i. A. Habitat. B–D. Habit. E. Inflorescence. F. Inflorescence with old anthers. G. Spikelets in early fruit. H, I. Spikelets with mature nutlets held by persistent anther filaments. Photos by F. & K. Starr. CC-BY 3.0.

Selected specimens examined: HAWAII: HAWAII ISLAND: along Saddle Road 23.5 miles from Hilo, 26 Aug. 1949, *O. Degener, Murashige & Kerr 20210* (BISH, US*); Mauka of Kulani Prison, 8 July 1961, *O. Degener & I. Degener 27833* (K, P*); Junction of Chain-of-Craters and quarry roads, Hawaii Volcanoes National Park, 23 Jan. 1967, *O. Degener 31073* (CBG); along jeep road, Kaupu-lekai Forest Reserve, NW slope of Hualalai, 9 July 1967, *O. Degener, I. Degener & A.B.H. Greenwell 31363* (L, NSW); Galathea Expeditionen, 1845–1847, *D.F. Didrichsen 3371* (BISH, C, NSW, US*); In volcano Kilauea, May 1909, *U.J. Faurie* 1250 bis (P 01869418*);

Kanehaha, Kona, 27 June 1911, *C.N. Forbes 270.H* (BISH, P*); [lava] flow of 1852, NE slope of Mauna Loa, 27 June 1915, *C.N. Forbes 961.H* (BISH, P*, US*); Hawaii Volcanoes National Park, Chain-of-Craters Road, just above Kokoolau Crater, 15 Mar. 1964, *F.R. Fosberg 45158* (US*); 3 miles W of Volcano House in National Park, 6 Aug. 1969, *J.S. Henrickson & L. Johnson 4077* (CSU; NSW); Kilauea, rim of crater, Kilauea Summer Camp, 4 Aug. 1927, *M.C. Neal s.n.* (BISH, P*); Kilauea volcano, Apr. 1911, *J.F.C. Rock & E.W. Giffard s.n.* (BISH, P*); Puu Hualalai, Puuwaawaa, 29 Dec. 1931, *H. St John et al. 11386* (BISH, P*, US); Kahuku parkland, 7 miles NE of Nene Cabin, 24 June 1971, *H. St John 26779* (BISH, NSW); upper Kalapana Trail, 25 June 1959, *B.C. Stone 2965* (BISH, P*). KAUAI ISLAND: Lihu District, Wahiawa headwaters, SE below Kapalaoa, 22 Dec. 2010, *K.R. Wood 14456* (BISH, MBK, NY*, US*). LANAI ISLAND: NW part of Munro Trail, Lanai, *O. Degener, I. Degener & R.W. Hobdy 24306* (NSW, US*); Puheilelu Ridge, Lanai, 13 Aug. 1963, *O. Degener & I. Degener 28328* (K, P*, UPS, US*); Lanai, upper part of mountain, 21 Sept. 1916, *A.S. Hitchcock 14653* (US*); Lanai, 1851–1855, *M.J. Remy 135* (BISH, P*); Lanai, Kaiholena Gulch, SW ridge of Kamoku, 4 Apr. 1947, *H. St John & R.S. Cowan 22607* (BISH, US*). MAUI ISLAND: Manawainui Gulch near Puu Anu, West Maui, 12 July 1927, *O. Degener 8342* (US*); between Red Hill and Kahua, Haleakala, Maui, 24 Nov. 1950, *O. Degener et al. 21110* (NSW); East Maui, east end of Haleakala Crater, 0.5 mile S of Paliiku Cabins, 16 June 1969, *J.S. Henrickson & R. Vogl 3490* (CSU; NSW, US*); Maui, *W.B. Hillebrand s.n.* (B, *n.v.*, MEL, NSW, US*); West Maui, Honokawai Gulch, Aug. 1910, *J.F.C. Rock 8192* (BISH, P*, US*); East Maui, Haleakala, Oct. 1910, *J.F.C. Rock 8518* (BISH, P*, US*); West Maui, Paunau - Kuhua divide, 19 Dec. 1936, *H. St John 17686* (BISH, CBG); Haleakala, slope side Maui, Oct. 1961, *W. Straatmas s.n.* (CANB 717848); W Maui, Hale Pohaku, 24 June 1992, *K.R. Wood & S. Perlean 1974* (US*). MOLOKAI ISLAND: Molokai, upper Kawela, 21 Sept. 1992, *G. Hughes 87* (US*). OAHU ISLAND: [Am Vulcan, *Macrae s.n.*, *n.v.*; Kaala Mountains, *Wilkes Expedition*, *n.v.*, both cited by Kükenthal (1943).] ISLAND UNKNOWN: Iles Sandwich, Voy. Bonite, Sept.–Oct. 1836, *C. Gaudichaud-Beaupré s.n.* (P*); Sandwich Islands, United States Exploring Expedition, 1838–1842, *Wilkes Exploring Expedition s.n.* (US 00426453*).

Conservation: Not threatened, but in some locations (e.g. Waiakeakua), the introduced grasses *Melinis repens* and *Schizachyrium condensatum* and the nitrogen-fixing tree *Morella faya* are crowding out *Morelotia* and other native species (D’Antonio *et al.* 2011), so monitoring should be undertaken. Conserved in a number of nature reserves including Volcanoes National Park. IUCN: Least Concern.

Etymology: Not stated by the author but presumably in reference to the similar form of the plant to species in the genus *Gahnia* J.R.Forst. & G.Forst., and specifically to the Hawaiian species *G. beecheyi*.

Common names: Gaudichaud’s sawsedge; ‘Uki.

Notes: Five sheets of the type collection of *Morelotia gahniiformis* have been located, which appear to represent a single collection. However, since the protologue is not specific on this, and there are multiple sheets at P, St John (1958) effectively selected a lectotype by differentiating the sheets at P in his publication, specifically using the term holotype in reference to one of the sheets, and physically labelling the sheets as ‘holotype’ and ‘isotypes’ respectively. In this case, ‘holotype’ is to be corrected to ‘lectotype’ (Art. 9.10; Turland *et al.* 2018).

As noted by St John (1958), there are several fruit of *M. affinis* in a packet on the lectotype sheet (and excluded from the lectotype selection), presumably those used for the illustration in t. XXIX, fig. 4 (Brongniart in Duperrey 1833).

Gaudichaud-Beaupré returned to the Sandwich Islands in Sept.–Oct. 1836 on the *Bonite* and re-collected *Morelotia gahniiformis* at that time, but after the species was named, so these specimens are not type material.

An illustration of *Morelotia gahniiformis* Gaudich. was published in volume 4, Botanique, part 4 of *Voy. Uranie*, on 24 Feb. 1827 (Stafleu and Cowan 1976). The illustration has the species name and numbered parts to the figure, and the figure explanation, which contains considerable detail, published on p. 4 of the same volume. This constitutes ‘an illustration with analysis’ which would be sufficient to validate the species, but the genus was not already published, and thus the species name is also invalid in this publication (Art. 35.1; Turland *et al.* 2018). Part 10, containing page 416, was published on 18 Sept. 1829 (Stafleu and Cowan 1976) and both the genus and species names are validated there.

Kükenthal (1943) did not designate a particular herbarium holding the type collection of *Gahnia gahniiformis* var. *elongata* Kük. He is known to have examined at least the material now at B and P. St John (1958) effectively selected a lectotype by differentiating the sheets at B and BM in his publication by describing the sheet at B as ‘holotype’, also physically labelling the sheets as ‘holotype’ and ‘isotypes’ respectively. In this case, ‘holotype’ is to be corrected to ‘lectotype’ (Art. 9.10; Turland *et al.* 2018). The lectotype (B 10 0296673) has a label with Kükenthal’s epithet in his own hand, is in the main collection used by Kükenthal, and it is an ample specimen.

This species has been included under *Gahnia* by some until relatively recently (Koyama 1990, 1999), but is now recognised under *Morelotia* (Bruhl 1990, 1995; Imada 2012).

Morelotia involuta (H.St John) J.J.Bruhl & R.L.Barrett, *Telopea* 24: 176 (2021).

Machaerina involuta H.St John, *Nordic J. Bot.* 4: 57, fig. 1 (1984).

Type: French Polynesia: Austral Islands, Bass Islands, Rapa Island [Rapa Iti], S of Morongota [Morongo Uta *pare* (fort)], 275 m alt., 8 July 1934, *H. St. John & J. Maireau 15434* (holo: BISH 1001238*; iso: BISH 1001239*, BISH 1001240*, BRI AQ0193095*, GH 00050565*, K, NSW 1099912!, NY 4106228*, P 00641812*, P 00641813*, SING 0064504*, US 00512838*).

Illustration: St John (1984; fig. 1).

Perennial tufted *herb*, 0.25–0.6 m high; plants clonal, 0.2–0.5 m across; rhizome thick, woody, short, branched, 10–15 mm diam., not pseudobulbous; old leaf sheaths covering the rhizome, breaking apart into fibres and becoming recurved with age, pale brown to dark brown; roots not sand-binding. *Culms* stout, erect, with 1 leafy node above the middle of the culm, trigonous, 1.3–1.7 mm diam., smooth, glabrous, base not or slightly enlarged. *Leaves* mostly basal, numerous, and 1 cauline; phyllotaxy loosely spirotristichous, sheath glabrous, open, 26–38 mm long, 4–5 mm wide, broader than the leaf lamina, pale brown, upper margin smooth, ligule absent; basal leaves 20–60 cm long, 2.5–4 mm wide, but involute and appearing 1–1.3 mm wide, lamina ±linear, often twisted or curved, finely multi-striate, glabrous, dark green, paler below, margins very finely scabrous, usually recurved, apex gradually attenuate; cauline leaf lamina 15–25 cm long. *Inflorescence* dense, panicle-like, narrow, linear, 10.5–21 cm long, 5–10 mm wide, with 5–8 fertile nodes; axis green; bracts leaf-like, with pale brown sheaths 15–25 mm long, becoming progressively smaller up the culm, exceeding the spikelet clusters, basal bract longer than inflorescence; branches 20–25 mm long, erect, with (1)2 or 3 clustered spikelets on peduncles 0.5–3 mm long, arising in each bract axil; spikelet prophyll present, sheath 3.5–4.2 mm long, brown, with 1 distinct vein, partially enclosing the spikelet, with a slender lamina 1.8–2.1 mm long, brown. *Spikelets* brown, lanceolate, 7–9 mm long, 1.3–1.5 mm diam., ascending, not compressed, with usually 7 glumes, only topmost fertile, bisexual, lower glumes empty, glumes distichous, lowest glume 4 mm long, upper glumes 8–9 mm long, 1.7–2.1 mm wide, glabrous, lanceolate, acuminate, weakly keeled, with a mucro to 3 mm long; rachilla compact and not sinuous in fruiting spikelets. *Perianth segments* present, bristles *c.* 6, inconspicuous, filiform, glabrous, 0.4–1.1 mm long, 1/5–1/3 as long as the nutlet. *Stamens* 3; anther connective 5.1–6.8 mm long, linear, persistent at base of nutlet, distal portion held within the convolute apex of subtending glume, so mature nutlets pendent on the inflorescence post-release; anthers pale yellow, 4–5 mm long, linear-oblong, base auriculate, with a glabrous apical appendage up to 2 mm long. *Style* 3-fid, white, base 3–5 mm long, glabrous, thin throughout, branches 7–10 mm long, hispidulous. *Nutlet* sessile, angular ellipsoid, subterete, but perceptibly 3-sided, mostly stramineous but apex brown and only slightly or not constricted, smooth, 2.1–2.7 mm long including the style base, 0.8–1.0 mm diam., epidermal cells square–hexagonal, but inconspicuous; style base cylindric, hard, persistent, glabrous, *c.* 0.5 mm long and wrinkled when immature, expanding to *c.* 0.7 mm long, smooth and somewhat angular due to continuation of ribs from nutlet; embryo not examined. Photosynthetic pathway not verified. (Figure 9).

Diagnostic characters: Differs from *M. affinis* in: Culms with 1 leafy node (*vs* 0–2(–4) leafy nodes), 1.3–1.7 (*vs* 1.9–3.5) mm diam. Leaf sheath 26–38 (*vs* 35–60) mm long. Basal leaves 2.5–4 (*vs* 4–8) mm wide, but involute and appearing 1–1.3 (*vs* 1.5–2.1) mm wide, margins very finely scabrous, (*vs* harshly scabrous), usually recurved (*vs* strongly revolute) when dry. Inflorescence branches 20–25 (*vs* 20–70) mm long, with (1)2 or 3 (*vs* 3–15) clustered spikelets. Perianth segments present, filiform, 0.4–1.1 mm long (*vs* absent). Nutlet mostly stramineous but apex brown (*vs* lustrous red-brown to black, apex black).

Distribution: Until 2020, only known from three collections made on a single expedition in July 1934, and four collections made in 2002 on Rapa Iti (Rapa Island), in the Austral Islands, French Polynesia. Targeted surveys for the species in March 2020 located seven populations on Rapa Iti where it is apparently endemic (Barrett *et al.* 2021b).

Habitat: Grassy volcanic crests and ridges in open, sunny areas, with *Aristida aspera*, *Asplenium polyodon*, *Athyrium membranaceum*, *Bolbitis lonchophora*, *Callistopteris calyculata*, *Coprosma rapensis*, *Cyathea medullaris*, *Cyperus brevifolius*, *Dryopteris stokesii*, *Dianella intermedia* var. *punctata*, *Dicranopteris linearis*, *Elaphoglossum meyeri*, *Eragrostis brownei*, *Erythrina variegata*, *Eurya rapensis*, *Ficinia nodosa*, *Fitchia rapensis*, *Gahnia aspera*, *Glochidion* species, *Histiopteris incisa*, *Hymenophyllum* sp., *Lycopodiella cernuua*, *Meterosideros collina*, *Peperomia rapensis*, *Pittosporum rapense*, *Rhynchospora stokesii*, *Vaccinium rapense*, and *Veronica rapensis* collected in the vicinity. Introduced taxa recorded in direct association include *Bidens pilosa*, *Miscanthus floridulus* and *Psidium cattleyanum*.

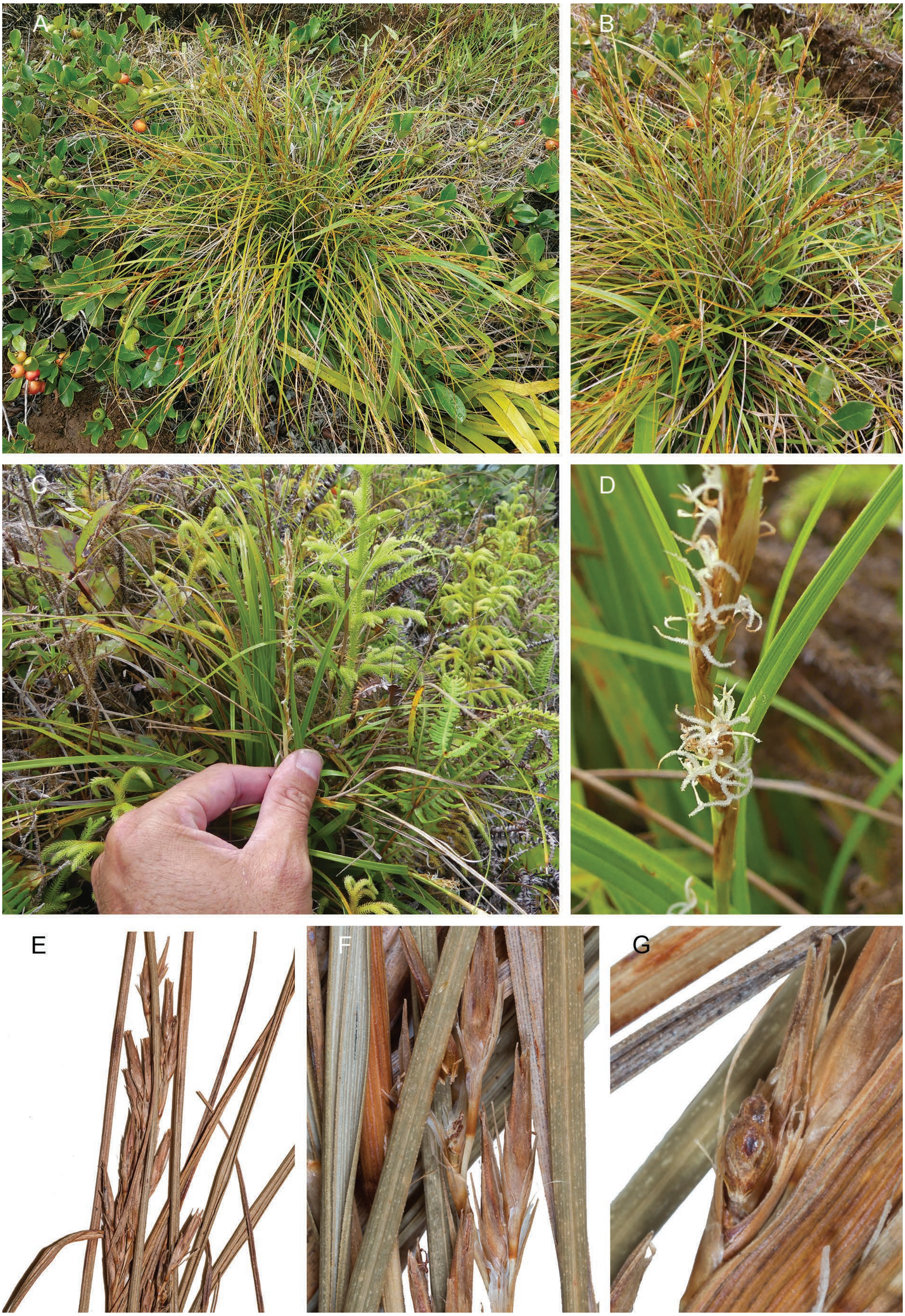

Fig. 9. *Morelotia involuta*. Rapa Iti, French Polynesia. A, B. Habit. C. Leaves and inflorescence. D. Inflorescence with styles. E. Inflorescence. F. Spikelets. G. Fruit in dissected spikelet. A–D from *R. Taputuarai 859, 860* (PAP). E–G from *H. St John 15434* (NSW). Photos: A–D by R. Taputuarai; E–G by R.L. Barrett.

Phenology: Flowers recorded for March and April. Fruit recorded for April and July.

Specimen images examined: French Polynesia: Austral Islands, Bass Islands, Rapa Iti, E slope of Mt Ruatara, 260 m., 9 July 1934, *F.R. Fosberg 11453* (L*, S*, US*), *loc. cit*., 8 July 1934, *F.R. Fosberg 11454* (P*, US*); sentier ver le Mont Maungaoa, 400 m, 21 Mar. 2002, *J-Y. Meyer 1007 & R. Fenstemacher* (PTBG 1000028324*); just west of Area village, 80 m, 19 Mar. 2002, *T.J. Motley 2621 & R. Fenstemacher*, collected by *J.-F.Butaud* (PTBG 1000028319*); Mt. Manguoa (Marugaoa) on ridge just east of Pa (fortress), 380 m, 8 Apr. 2002, *T.J. Motley 2721 & R. Fenstemacher* (PTBG 1000028323*); Hiri Valley, back slopes below Pukumaru Peak, north facing slope, 400 ft, 13 Apr. 2002, *S. Perlman 18062* (PTBG 1000028318*).

Conservation: Poorly known, but native vegetation on Rapa Iti has suffered greatly from human overpopulation in the past and the ongoing presence of feral animals (Prebble and Anderson 2012). In addition, remnant native habitats are commonly heavily invaded by *Miconia calvescens*, *Psidium cattleyanum*, *Rubus rosifolius*, *Hedychium flavescens* and weedy grasses, particularly *Melinis minutiflora*, *Miscanthus floridulus* and several *Paspalum* species (Mueller-Dombois and Fosberg 1998; Meyer 2004; Meyer *et al*. 2015, 2019), and this species is likely to be threatened by habitat loss. It is noted that Brown (1931) did not examine any material of this taxon for his treatment of Cyperaceae the *Flora of Southeastern Polynesia*, despite collections of other Cyperaceae from nearby locations on Rapa, suggesting the species may have already been quite rare at the time of preceding expeditions, though it may have simply been overlooked for the diversity of 'more interesting' species on the island.

Barrett *et al*. (2021b) assessed the conservation status of *Morelotia involuta* following the IUCN (2012) criteria for endangerment as Endangered (EN). The IUCN alphanumeric summary of the evaluation of criteria and subcriteria is: B1b(iii, iv); B2a; B2b(iii); C1; C2a(i); D2.

Etymology: Named from the Latin *involvere* (to roll in) in reference to the involute leaf lamina.

Notes: St John (1984) allied his *Machaerina involuta* to *M. schoenoides* (R.Br.) Koyama [=*Machaerina acuta* (Labill.) J.Kern], a relationship that is only based on superficial morphological similarities.

Most of the fruit on the isotype at NSW are immature, with small style bases, but a few mature fruit are present, with greatly enlarged style bases.

Morelotia microcarpa (S.T.Blake) R.L.Barrett & K.L.Wilson, ***comb. nov.***

Basionym: *Tetraria microcarpa* S.T.Blake, *Proc. Roy. Soc. Queensland* 60: 52 (1949).

Type: Western Australia: South-West Division: 10–20 miles N of Northampton, in sandy heath, 3 September 1947, *S.T. Blake 18138* (holo: BRI; iso: CANB 251338 (2 sheets), K 000960100, L 0042808, MEL 2297586, NSW 687520, PERTH 1049593).

Perennial tufted herb, 0.2–0.4(–0.6) m high; plants clonal, 0.1–0.4 m across; rhizome thick, woody, short, branched, 6–8 mm diam., pseudobulbous; old leaf sheaths covering the rhizome, breaking apart into fine fibres with age, pale brown; roots sand-binding. *Culms* stout, erect, with 1 leafy node, below the inflorescence at least obtusely trigonous, becoming grooved, 1.1–1.3 mm diam., rugulose-asperulous and angles scabrid. *Leaves* mostly basal, numerous, and 1 cauline; phyllotaxy loosely spirotristichous, sheath margins scabrid, otherwise glabrous, 8–30 mm long, 1.5–2.0 mm wide, ± equal width to the leaf lamina, green or pale brown, upper margin membranous, oblique, finely ciliate, ligule absent; cauline sheath tight around culm; basal leaves often exceeding the culms, 16–38(–60) cm long, 2–2.5 mm wide; bases white-membranous, dividing and becoming fimbriate; lamina ± linear, flat or ± complicate, ± flexuous, old leaf tips curling, finely multi-striate, margins scabrid, otherwise glabrous when young, green, concolorous, keeled along mid-nerve, with 3 primary impressed nerves, margins ribbed and finely scabrous, commonly recurved, apex long-attenuate, setaceous; lowest leaves reduced to a sheath, lacking a lamina, pale brown. *Inflorescence* subspiciform panicle-like, narrow, linear, ± flexuous, with 5–7 nodes, 6–15(–25) cm long, 7–10 mm wide, interrupted, axis green or yellow-green, not glaucous; bracts leaf-like, greatly exceeding the spikelet clusters, sheaths in the lower part of the inflorescence open, not enveloping the higher bracts, gradually reducing along the inflorescence, basal bract as long to much longer than inflorescence, to 16 cm long; branches erect, 8–40 mm long, with 12–20 densely clustered (ovoid, head-like, heads 7–10 mm long, 6–7 mm wide), spikelets on short, compressed, scaberulous, peduncles 0.5–3 mm long, arising in each bract axil; spikelet prophyll present, sheath 2.4–2.6 mm long, brown, with 1 distinct vein, partially enclosing the spikelet, with a slender lamina 0.9–1.2 mm long, brown. *Spikelets* dark brown, lanceolate, 3.5–4 mm long, laterally compressed, with usually 6 glumes, only topmost 3 fertile, the lower 2 flowers bisexual but often reduced and infertile, the upper flower bisexual, fertile; glumes distichous, basal glume 1.2–2.2 mm long, upper glumes 2.6–3.4 mm long, 0.7–0.9 mm wide, membranous, brown with pale red stripes, scabrous on the margins and keel and sparsely scabrous on the lamina, lanceolate, acute to acuminate, with a mucro to 3 mm long, keel distinct; rachilla compact and not or scarcely sinuous in fruiting spikelets. *Perianth segments* 2, thin, minute or absent. *Stamens* 3; anther connective 1.8–2.5 mm long, subulate; anthers yellow, 0.8–0.9 mm long, with a glabrous apical appendage up to 0.2 mm long. *Style* trifid, base 1.8–2.3 mm long, glabrous, slender above, dilated below, branches 1.3–1.5 mm long, hispidulous. *Nutlet* shortly stipitate, broadly obovoid or globular, 1.4–1.7 mm long including the stipe and style base, 0.8–1.2 mm diam., faces smooth, glabrous, epidermal cells square–hexagonal, inconspicuous, cell surface raised so appears very finely papillose at 20× magnification, with three raised, white ribs which broaden above the nut to form the enlarged, thick, persistent, pyramidal or conical style base; embryo not examined. Photosynthetic pathway not examined. (Figure 10).

Fig. 10. *Morelotia microcarpa*. A. Habit. B. Plant base. C, D. Infructescence. E, F. Inflorescence. A, D from *R.L.Barrett, M.D. Barrett & C. Karsten RLB 5105* (PERTH); B, C, from *K.L. Wilson 2628* (NSW); E, F, from *J.M. Collins, S. Crees & M. Davis JMC 423* (NSW). Photos by R.L. Barrett.

Diagnostic characters: Differs from *Morelotia octandra* in its much smaller dimensions in all parts; compact rachilla (*vs* sinuous around nutlet); 3 (*vs* usually 8) anthers; glabrous (*vs* hairy) style base and shortly stipitate (*vs* sessile) nutlet base.

Distribution: Endemic to the south-west of Western Australia where it is widespread on the northern sandplain, from north of Kalbarri south and east through the wheatbelt to Cocklebiddy on the edge of the Great Australian Bight, and an apparently disjunct population in the Great Victoria Desert.

Habitat: Recorded in open, low to tall heath, sometimes with scattered mallee eucalypts, on sandplains, sand dunes, sometimes over limestone and gravel in white, grey, brown or yellow sand, sometimes with white or red clay. Recorded in association with *Acacia acuminata*, *A. latipes*, *A. spathulifolia*, *Acanthocarpus canaliculatus*, *Allocasuarina campestris*, *Amphipogon caricinus*, *Austrostipa macalpinei*, *Baeckea pentagonantha*, *B.* sp. Yuna (M.E.Trudgen 2224), *Banksia prionotes*, *B. sceptrum*, *Blennospora drummondii*, *Bromus arenarius*, *Brunonia australis*, *Calandrinia eremaea*, *Callitris arenaria*, *C. canescens*, *Calothamnus phellosus*, *Calytrix brevifolia*, *C. harvestiana*, *Chamelaucium drummondii*, *Chrysitrix distigmatosa*, *Conospermum stoechadis*, *Dichopogon fimbriatus*, *Ecdeiocolea monostachya*, *E. rigens*, *Enekbatus sessilis*, *Eremaea pauciflora*, *Eucalyptus eudesmioides*, *E. obtusiflora*, *E. oldfieldii*, *Gahnia drummondii*, *Grevillea amplexans*, *G. candelabroides*, *Hakea scoparia*, *Hemigenia scabra*, *Jacksonia velutina*, *Lechenaultia macrantha*, *Lepidosperma tenue*, *Leptospermum erubescens*, *Melaleuca concreta*, *M. stereophloia*, *Mesomelaena preissii*, *M. pseudostygia*, *M. stygia*, *Mirbelia longifolia*, *Monachather paradoxus*, *Netrostylis* sp. Mt Madden (C.D. Turley 40 BP/897), *Pileanthus pedunculatus*, *Rhodanthe manglesii*, *Scaevola spinescens*, *Schoenus caespititius*, *S. clandestinus*, *S. latitans*, *S. racemosus*, *S. subaphyllus*, *S.* sp. G Broad Sheath (K.L.Wilson 2633), *Tersonia cyathiflora*, *Thysanotus patersonii*, *Trachymene pilosa*, *Tricostularia neesii*, *Triodia danthonioides*, *Velleia rosea*, *Verticordia centipeda*, *V. chrysostachys*, *V. spicata*, *Xanthorrhoea* sp. and *Xylomelum angustifolium*.

Phenology: Flowers recorded for August–November. Fruit recorded for September–December.

Selected specimens examined: WESTERN AUSTRALIA: *c.* 6 km along the track to the Z-bend from the intersection with the Ajana-Kalbarri Road, 5 Sept. 1990, *D.E. Albrecht 4216* (NSW); Greenough, Aug. 1903, *C.P.R. Andrews s.n.* (NSW 687522); E side of Wandin Creek, 0.5–1.2 km S of Campbells Road, East Yuna Nature Reserve, *c.* 30 km NW of Mullewa, 19 Sept. 2008, *R.L.Barrett, M.D. Barrett & C. Karsten RLB 5105* (PERTH); *c.* 2 km W of Moore Road on Geraldton–Mt Magnet Road, 20 Oct. 2008, *R.L. Barrett & B.G. Briggs RLB 5274* (PERTH); private property Location number 26758 in remnant E of Magboom Lake, Shire of Goomalling, N of Meckering, 15 Nov. 2007, *J.M. Collins, S. Crees & M. Davis JMC 423* (NSW, PERTH); 9 km W of Kalbarri along road to Highway 1, 1 Oct. 1979, *M.D. Crisp 6294* (CBG, NSW); along State Vermin Fence No. 7, between 45 km and 65 km S of Great Eastern Highway, 5 Nov. 1985, *J. Dodd 254* (CANB, PERTH); 292 km from Mount Magnet on Geraldton Road, 30 Oct. 1963, *D.W. Goodall 2146* (PERTH); Kalbarri National Park, 7 Aug. 1976, *R.J. Hnatiuk 760523* (NSW, PERTH); Cooloomia Nature Reserve, 40 km W of Nerren Nerren Homestead, 69 km N of Kalbarri, 23 Aug. 1983, *S.D. Hopper 3299* (PERTH); Frank Hann National Park, 12 Oct. 1978, *D. Monk 393* (PERTH); Lake Mears Nature Reserve, 15 May 1999, *D.E. Murfet 3543* (AD, PERTH); 11 km SSE of Lake Cairlocup, 16 June 1974, *K.R. Newbey 4218* (PERTH); 23 km S of Tadpole Lake, Frank Hann National Park, *c.* 63 km ENE of Lake King, 21 July 1979, *K.R. Newbey 5380* (NSW, PERTH); 12 km SW of Mount Buraminya, *c.* 40 km WNW of Mount Ragged, 8 Nov. 1980, *K.R. Newbey 8214* (NSW, PERTH); 57 km S of Marvel Loch, 22 July 1981, *K.R. Newbey 8338* (NSW, PERTH); 10.5 km E of Kalbarri, Kalbarri National Park, 24 Oct. 1981, *K.R. Newbey 9363* (NSW, PERTH); 14 km N of Northampton on NW Coastal Highway, 23 Sept. 1976, *T. Whaite & J. Whaite 4173* (NSW); 16 km N of Northampton on Ajana Road, 28 Sept. 1979, *K.L. Wilson 2628* (NSW); 20 km S of Cocklebiddy on track to Twilight Cove, 3 Dec. 1994, *K.L. Wilson 9259* (NSW); North West Coastal Highway, 15 km N of Northampton, 13 Sept. 2012, *K.L. Wilson 10841* (NSW); 13.1 km N of Murchison River (Galena Bridge) on NW Highway, 25 Sept. 2014, *K.L. Wilson & A. Wilson* (MEL, NSW, PERTH).

Conservation: Widespread and not considered threatened. Conserved in Kalbarri National Park, Watheroo National Park, Frank Hann National Park, Lake Mears Nature Reserve and Nuytsland Nature Reserve.

Notes: This relatively diminutive species remains poorly known as it grows in areas with low rainfall and many of the collections are not in good fertile condition, having only old inflorescences. Further assessment of regional variation is recommended once more collections become available, particularly from the southern and eastern extent of its range.

Morelotia octandra (Nees) R.L.Barrett & J.J.Bruhl, ***comb. nov.***

Basionym: *Elynanthus octandrus* Nees, *Ann. Mag. Nat. Hist.* 6: 48 (1841)

Tetrariopsis octandra (Nees) C.B.Clarke, *Bull. Misc. Inf., Kew – Add. Ser.* 8: 45 (1908). *Schoenus octandrus* (Nees) F.Muell., *Fragm.* 9(73): 31 (1875). *Tetraria octandra* (Nees) Kük., *Repert. Spec. Nov. Regni Veg.* 29: 193 (1931).

Type citation: "ad flumen Cygnorum lectae. Drummond."

Type: Western Australia: Swan River [colony], 1839, *J. Drummond s.n.* (holotype: CGE; isotype: K 000960098!); possible isotype: Western Australia: *J. Drummond 939* (MEL 2203859).

Elynanthus revolutus Nees ex Lehm., *Nov. Stirp. Pug.* 8: 54 (1844).

Type citation: "Habitat in locis glareosis inter frutices montis Greenmountain (Perth.). (Herb. Preiss. no. 1769.)"

Type: Western Australia: Greenmount Hill, near Perth, 26 Apr. 1840, *L. Preiss* [*Plantae Preissianae No. 1769*] (holotype: LD 1732179!).

Tetrariopsis octandra C.B.Clarke in L.Diels & E.Pritzel, *Bot. Jahrb. Syst., Pflanzenges. Pflanzengeog.* 35(1): 81 (1904), *nom. inval.*

Illustrations: Clarke (1909: tab. LXXXI(5), p. 81); Metcalfe (1971; fig. 65e, f); Dell and Bennett (1986: fig 65j); Bruhl (1995; fig. 6.4); Scott and Negus (2002: fig. 3, p. 23); Wheeler and Graham (2002: fig., p. 298); Barrett and Tay (2015: pl. 1–3, p. 203); Keeble (2017, pl. p. 81).

Perennial tufted herb, 0.7–1.2 m high; plants clonal, 0.2–0.8 m across; rhizome thick, woody, short, branched, 10–15 mm diam., pseudobulbous; old leaf sheaths covering the rhizome, breaking apart into fibres with age, dark brown to blackish brown; roots sand-binding. *Culms* stout, erect, with none or 1 leafy node, ± terete at the base but very obtusely 3-angled below and within the inflorescence, 1.0–3.5 mm diam., multi-striate, glabrous. *Leaves* mostly basal, numerous, and with none or 1 cauline; phyllotaxy loosely spirotristichous, sheath glabrous, tight around culm, 18–35 mm long, 1–3 mm wide, ± equal width to the leaf lamina, dark brown to blackish brown, upper margin with fine, blunt scabrous projections, ligule absent; basal leaves 15–60 cm long, 2–4 mm wide, lamina ± linear, often twisted or curved, finely multi-striate, glabrous, dark green, slightly paler below, margins finely bluntly scabrous, revolute, apex long-attenuate. *Inflorescence* open, panicle-like, narrow, linear to lanceolate, 13–35 cm long, 10–20 mm wide, axis green, not glaucous; with 3 or 4 nodes; bracts leaf-like, becoming progressively smaller up the culm, ± equal to greatly exceeding the spikelet clusters, basal bract usually shorter than inflorescence; branches erect, with 2 or 3 clustered spikelets on peduncles 0.5–5 mm long, arising in each bract axil; spikelet prophyll present, sheath 3.2–4.5 mm long, brown, with 3 distinct veins, partially enclosing the spikelet, with a slender lamina 2.1–8.5 mm long, green. *Spikelets* chestnut to brown, ovate, 10–15 mm long, not compressed, with usually 7, rarely 9, glumes, upper glume with a sterile male flower, second upper glume bisexual fertile, lower glumes empty (?rarely the 3rd upper glume with a bisexual sterile flower), glumes spirodistichous, basal glume 5.0–7.8 mm long, fertile glumes 7.2–11.5 mm long, 1.8–2.9 mm wide, scabrous to pubescent, especially on keel and towards the apex, elliptic-lanceolate, acute to acuminate, weakly keeled, with a mucro 0.5–1.0 mm long; rachilla compact and only shortly sinuous around nutlet in fruiting spikelets. *Perianth segments* absent. *Stamens* (4 or 6)8(9); anther connective 5.3–8.4 mm long, linear; anthers pale yellow, 4.4–6.2 mm long, linear-oblong, base auriculate, with a glabrous apical appendage up to 1.4 mm long. *Style* 3–5-branched, base 5.5–7.3 mm long, finely scabrous, thin above, dilated below, branches 2.5–3.3 mm long. *Nutlet* pale brown, sessile, angular globose, strongly 3–5-ribbed, 4.5–5.1 mm long including the style base, 1.6–1.8 mm diam., epidermal cells square–hexagonal, but inconspicuous; apex with a very distinct persistent style base, depressed-ovoid, somewhat constricted at the base, scabrous-pubescent, 1.5–2.0 mm long; embryo not examined. Photosynthetic pathway inferred from anatomy to be C_3 (*Blake 2240*; *Seabrook 130*; *P.G. Wilson 3965*; Bruhl & Wilson 2007). 1C = 0.23 pg (*R.L. Barrett RLB 7787*; Bureš *et al*. 2013). (Figure 11).

Diagnostic characters: Differs from *Morelotia australiensis* in its 0 or 1 (*vs* 3 or 4) nodes below the inflorescence; glabrous (*vs* pubescent) leaf sheath; leaf lamina 15–60 (*vs* 12–18) cm long; spikelets 10–15 (*vs* 8–10) mm long; 7–9 scabrous to pubescent (*vs* 5 glabrous) glumes; rachilla curved around the nutlet (*vs* compact); and usually 8 (*vs* usually 6) anthers.

Distribution: Endemic to the south-west of Western Australia where it is relatively common but scattered in near-coastal areas from Eneabba on the northern sandplains, Swan Coastal Plain and the Darling Scarp, south to Albany.

Habitat: Variously recorded on coastal sandplains, in sandy heath, lateritic gravelly sand, in sandy clay loam over laterite, in woodland, red clay loam, winter wet loam over granite, and on slopes with outcropping granite. Recorded in association with *Allocasuarina fraseriana*, *A. humilis*, *Ammothryon grandiflorum*, *Anigozanthos manglesii*, *Astroloma ciliatum*, *Banksia attenuata*, *B. coccinea*, *B. grandis*, *B. ilicifolia*, *B. menziesii*, *B. sessilis*, *Burchardia congesta*, *Caesia micrantha*, *Caustis dioica*, *Corymbia calophylla*, *Eremaea pauciflora*, *Eucalyptus marginata*, *Lepidosperma* spp., *Lyginia imberbis*, *Macarthuria australis*, *Mesomelaena pseudostygia*, *Morelotia australiensis*, *Schoenus benthamii*, *Stylidium carnosum*, *Thysanotus sparteus*, *Xanthorrhoea brunonis* and *X. preissii*.

Persistent in the landscape due to its clonal growth, with individuals tracked for over 30 years in Kings Park, Perth, and observed to resprout very quickly post-fire (Baird 1977).

Phenology: Flowers recorded for May–November. Fruit recorded for October–December.

Fig. 11. *Morelotia octandra*. A. Habit. B. Plant base with leaves. C. Leaf sheaths showing rhizome section. D–F. Inflorescence. G, H. Spikelets with fresh anthers. I. Spikelets with styles. A, D–G from *R.L. Barrett RLB 7787* (PERTH); B from *K.L. Wilson 3045* (NSW); C from *H. Salasoo 4147* (NSW). Photos A–G by R.L. Barrett; H, I by K.R.Theile.

Selected specimens examined: WESTERN AUSTRALIA: West of Mount Barker, 30 Sept. 1970, *A.M. Ashby 3651* (AD, NSW, PERTH); Hi Vallee Farm, Property of D. & J. Williams, N side of Tootbardie Road, *R.L. Barrett & B.G. Briggs RLB 5251A* (PERTH); Kings Park, Perth, 17 July 2012, *R.L. Barrett RLB 7787* (PERTH); 12 km from Manypeaks along Highway 1 towards Jerramungup, 13 Jan. 1979, *M.D. Crisp 5084* (CBG, NSW); Kamballup Rubbish Reserve, Woogenellup Rd, Kamballup, 12 Aug. 1997, *E.J. Croxford 7771* (PERTH); 10 km N of Wandering, 5 Dec. 1996, *R. Davis 1660* (PERTH); 700 m N along Yarra Road from junction of Brookton

Highway, 22 Feb. 2001, *R. Davis 9533* (PERTH); Kalamunda, 19 km E of Perth, 2 Aug. 1985, *R. Hamilton & M. Hamilton 141* (MEL, NSW, PERTH); Hi Vallee property, Warradarge, 9 July 1999, *M. Hislop 1334* (PERTH); Mount Frankland National Park, 36.1 km S of Shannon along Western Highway, 7 Oct. 2003, *J. Hodgon 795* (NE, NSW); Bow River, Jan. 1913, *S.W. Jackson s.n.* (K, NSW); western side of Mount Manypeaks, 40 km E of Albany, 20 July 1986, *G.J. Keighery 8218* (CANB, PERTH); Wooroloo, Sept. 1907, *M. Koch 1641* (K); slope above W bank of Helena River, *c.* 9.5 km WNW of Mundaring Weir, 2 Sept. 1995, *B.J. Lepschi 1950* (CANB, PERTH); 25 km NNE of Jurien, 24 Sept. 1981, *K.R. Newbey 9394* (CANB, NSW, PERTH); Swan River, Mount Eliza [Kings Park], Perth, June 1839, *L. Preiss* [*Plantae Preissianae No. 1770*] (HBG, K, LD, MEL); sandy woodland between the town of Perth and the city of Fremantle, Dec. 1838, *L. Preiss* [*Plantae Preissianae No. 1771*] [excl. piece of *Lepidosperma gladiatum*] (LD); Perth suburb Daglish, 23 Sept. 1970, *H. Salasoo 4147* (NSW); Witchcliffe townsite, 15 Sept. 2001, *J. Scott 433* (PERTH); Hawkesvale Bushland Conservation Area, Hazelmere, 11 Aug. 2007, *K.R. Thiele 3321* (PERTH); 8 km NE from Midland on Toodyay Road, 14 Sept. 1976, *T. Whaite & J. Whaite 4107* (NSW); Walpole-Nornalup National Park, track to Blue Holes, 13 Aug. 1992, *J.R. Wheeler 3165* (PERTH); 1.5 km from Chester Pass Road on Stirling Range Drive, 19 Oct. 1979, *K.L. Wilson 2995* (NSW); Three Chain Road, 3.5 km W of McGregor Road towards Scott River Road, 21 Oct. 1979, *K.L. Wilson 3045* (NSW); Gales Road, Ambergate, 22 Oct. 1979, *K.L. Wilson 3062* (NSW); 12 km S of Busselton, Ambergate Regional Park, Darling District, 14 Nov. 1994, *K.L. Wilson, K. Frank, G.J. Keighery & N. Gibson KLW 8896* (NSW, PERTH); Clackline–Toodyay road, *c.* 7.4 km N of Great Eastern Highway, 22 Sept. 2014, *K.L. Wilson 11169* (NSW); 7 km E of Mt. Barker, 19 Sept. 1964, *P.G. Wilson 3363* (AD, PERTH); 28 km S of Collie, 14 Dec. 1965, *P.G. Wilson 3965* (CANB, NSW, PERTH).

Conservation: Widespread and well conserved, including in Kings Park, Porongurup National Park and Stirling Range National Park. IUCN: Least Concern.

Notes: Clarke (1908) created a new genus *Tetrariopsis* for this species, relating it to *Elynanthus* (then incorporating *Tetraria*, now a synonym of *Schoenus*) on the basis of spikelets with 7 glumes, 2-flowered spikelets, the short rachilla, perianth absent, stamens 8, styles 3–5-fid and nutlets globose, with 3–5 ribs and a depressed-ovoid persistent style base. Kükenthal (1931) gave a detailed discussion on the morphological affinities and differences between *Tetraria*, *Tetrariopsis* and *Macrochaetium* Steud. (=*Cyathocoma* Nees). Kükenthal (1931) dismissed the shape of the spikelets and glumes as not significantly different to *Tetraria*, and identified the sexuality of the flowers as the key feature to be assessed. Kükenthal (1931) found that the upper flower in *Tetrariopsis* is bisexual, but usually only male fertile, and the second flower bisexual fertile, the reverse arrangement to *Tetraria*. However, some spikelets were found to have two bisexual fertile flowers, and some with only 4 anthers. A single specimen (*Diels 2513*) from the Serpentine River had the upper flower bisexual fertile, and the lower flower infertile, but we have not been able to find material of this collection and while it may be correct, it cannot be ruled out that this may have been *Morelotia australiensis*. Exceptions to the general pattern in *Tetraria* were claimed for *T. cuspidata* (Rottb.) C.B.Clarke (=*Schoenus cuspidatus* Rottb.), *T. bachmannii* Kük. (=*Cyathocoma bachmannii* (Kük.) C.Archer) and *T. thuarii* P.Beauv. (=*Schoenus compar* L.), but none of these species remains in *Tetraria* as defined here.

The type material at CGE and K has no collection number (*J. Drummond s.n.*). There is a specimen at MEL (MEL 2203859) that is a possible isotype (*J. Drummond 939*) as Drummond's collection numbers were commonly omitted or lost when labels were transcribed and we have found no evidence that Drummond collected this species twice.

Tetraria P.Beauv., *Mem. Inst. Fr.* 16: 54 (1816), *nom. cons. prop.* (see Larridon *et al. Taxon* 66: 1226, 2018).

Type species: *Tetraria thermalis* (L.) C.B.Clarke, *typ. cons. prop.* (see Larridon *et al. Taxon* 66: 1226, 2018).

Schoenopsis P.Beauv. ex T.Lestib., *Essai Cypér*. 34 (1819).

Type species: *Schoenopsis flexuosa* (Thunb.) Nees, designated by Larridon *et al. S. Afr. J. Bot.* 118: 21 (2018).

Lepisia C.Presl, *Lepisia* (preprint 1829); *Symb. Bot.* 1: 9 (1830). *Tetraria* sect. *Lepisia* (C. Presl) C.B.Clarke, *Bull. Misc. Inform. Kew, Addit. Ser.* 8: 126 (1908).

Type species: *Lepisia ustulata* (L.) C.Presl.

Sclerochaetium Nees, *Linnaea* 7: 511 (1832).

Type species: *Sclerochaetium thermale* (L.) Nees, designated by Larridon *et al. S. Afr. J. Bot.* 118: 22 (2018).

Aulacorhynchus Nees, *Linnaea* 9: 305 (1834). *Tetraria* sect. *Aulacorhynchus* (Nees) C.B.Clarke, *Bull. Misc. Inform. Kew, Addit. Ser.* 8: 126 (1908).

Type species: *Aulacorhynchus crinifolius* Nees.

Boeckeleria T.Durand, *Index Gen. Phan.* 504 (1888). *Decalepis* Boeckeler, *Bot. Jahrb. Syst.* 5: 509 (1884), *nom. illeg.*

Type species: *Decalepis dregeana* Boeckeler.

Lophoschoenus Stapf, *J. Linn. Soc., Bot.* 42: 179 (1914).

Type species: *Lophoschoenus arundinaceus* (Sol. ex Vahl) Stapf.

Perennial tufted herbs, 0.3–3.0 m high; plants clonal, compact to open, clones 0.2–2 m across; rhizome thick, woody, short, branched, 1–45 mm diam., non-pseudobulbous; old leaf sheaths covering the rhizome, breaking apart into fine fibres with age, reddish brown to dark brown; roots sand-binding. *Caudex* absent or present. *Culms* slender to stout, rigid, erect to spreading or sometimes arcuate, 30–150 cm long below inflorescence, with 0–5 nodes, terete or trigonous, usually finely striate, 0.5–8 mm diam., glabrous, green, base not enlarged. *Leaves* mostly basal, numerous, and 0–5 cauline; phyllotaxy loosely spirotristichous; sheath 18–82(–92) mm long, 1.0–1.9 mm wide, broader or narrower than the leaf lamina, margins rapidly breaking apart, glabrous or ciliate, chestnut-brown or brown, often shiny, upper margin narrowly membranous, oblique to truncate, ligule absent; cauline sheath tight or loose around culm, brown or dark brown to black; *pseudopetiole* usually obscure or absent; leaves usually not exceeding the culms, lamina dorsiventral, 6–100 cm long, 0.5–24 mm wide; bases not differentiated; lamina ± linear, flat, involute or channelled throughout and commonly ± V-shaped in section, ± flexuous, old leaf tips not or sometimes curling, finely multi-striate, lamina usually glabrous, green to yellow green, ± concolorous, often strongly keeled along mid-nerve, margins very finely scabrous, usually entire but sometimes denticulate, flat to involute, apex long-attenuate; lowest leaves usually not reduced to a sheath. *Inflorescence* dense to open, but usually elongate panicle-like (sometimes sub-capitate), usually narrow, ± linear to lanceolate, ± erect or sometimes arcuate, with 1–11 nodes, 6–80 cm long, 0.8–10 cm wide, interrupted to ± continuous, axis green to yellow-green, not glaucous; bracts usually reduced leaf-like at the base, usually bract-like with a slender lamina above, usually exceeding the branchlets, sheaths open, not enveloping the higher bracts, gradually reducing along the inflorescence, basal bract usually somewhat shorter than to exceeding inflorescence, 6–50 cm long; basal branchlets 2.5–20 cm long, 1 or 2 arising in each bract axil; branches erect, each with 1–6 spikelets, spikelets solitary or appearing paired on compressed, scabrous-margined peduncles 0.5–15 mm long. *Spikelet prophyll present*, sheath 1.3–16 mm long, brown, midrib distinct, partially enclosing the spikelet, with a slender lamina 0.3–7.5 mm long, brown. *Spikelets* 3–100+ per inflorescence, brown, elliptic to lanceolate, 4.7–25 mm long, 1.1–3.7 mm wide, subterete, 5–9 glumes, only topmost 2 or 3 fertile, lower flower bisexual, functionally male, upper 1 or 2 bisexual, fertile, usually no reduced glume above the florets (present in *T. cernua*); glumes distichous, basal glume 1.1–15 mm long, fertile glumes 4.1–15 mm long, 0.8–3.5 mm wide, membranous, brown or red-brown, glabrous or ciliate on the keel, margins translucent and often minutely ciliate, lamina glabrous to minutely scabrid, ovate, acute, usually with a mucro 0.5–12 mm long, keel sometimes distinct only towards the apex; rachilla compact and not sinuous in fruiting spikelets. *Perianth segments* absent or 6, whitish, 0.4–5 mm long, *c.* one quarter to as long as the nutlet, base not usually dilated, filiform to subulate, tapering to a fine point, margins glabrous or scabrous. *Stamens* 3; anther connective 3.4–16 mm long, subulate; anthers yellow, 2.3–3.8 mm long, with a glabrous or scaberulous apical appendage 0.4–1.1 mm long. *Style* 3- or 4-fid, base 2.7–9 mm long, slender and usually hispidulous in upper half, slender to slightly enlarged and glabrous in lower half, branches 1.6–10 mm long, hispidulous. *Nutlet* distinctly stipitate, constricted, obovoid to broad-ellipsoid, obscurely trigonous, usually dull, pale brown to dark brown, 1.3–11 mm long including the stipe and persistent portion of the style base, 0.5–4.5 mm diam., faces ± smooth (can appear finely papillose) or tuberculate, glabrous, epidermal cells ± oblong to ovate, inconspicuous, with 3 or 4 fine white ribs, style base not or slightly enlarged, thick, persistent, cap-like to shortly pyramidal; embryo Schoenus-type. Photosynthetic pathway C_3.

Diagnostic characters: Differs from *Morelotia* in having distinctly stipitate nutlets (*vs* ± sessile, or shortly stipitate in *M. microcarpa*). The leaf sheaths are usually much more divided in *Tetraria* species, though they can be somewhat divided in some *Morelotia* species.

Distribution: Most species are endemic to southern Africa, with seven species endemic to New Caledonia, and one in Borneo.

Notes: The delimitation of *Tetraria* has been problematic for most of its history (Clarke 1894, 1897–1898; Kükenthal 1940; Levyns 1947, 1950; Compton 1976; Browning and Gordon Gray 1995a, b; Slingsby and Verboom 2006; Verboom 2006; Viljoen *et al.* 2013; Slingsby *et al.* 2014; Muasya 2016; Browning and Goetghebeur 2017; Larridon *et al.* 2018b). A refined delimitation has been provided by Larridon *et al.* (2018b) that includes about 39 species. One *Tetraria* species from Asia awaits transfer to another genus (R.L. Barrett & I. Larridon, unpubl. data), following the removal of all Australian species formerly included in *Tetraria* by Barrett *et al.* (2021b) and in this paper.

The generic description above is based primarily on the four species treated here in detail, and while they were chosen to represent the greatest range of morphological diversity in the genus, it is likely that some modification to the generic description will be required once all species have been examined in detail. At least four of the South African species require taxonomic revision (G.A. Verboom *pers. comm.*).

A key to *Tetraria* species is not provided as only selected species have been examined for this study. Most South African species are keyed out in Kükenthal (1940), Raynal (1974) provides a table of diagnostic characters for the New Caledonian species, and Kern (1974) describes the Asian species.

Tetraria arundinacea (Sol. ex Vahl) T.Koyama, *J. Fac. Sci. Univ. Tokyo, Sect. 3, Bot.* 8: 74 (1961).

Schoenus arundinaceus Sol. ex Vahl, *Enum. Pl. Obs.* 2: 220 (1805). *Carpha arundinacea* (Sol. ex Vahl) Brongn., *Voy Monde* 2: 169, t. 30 (1829). *Chaetospora arundinacea* (Sol. ex Vahl) A.Dietr., *Sp. Pl.* 2: 31 (1833). *Asterochaete arundinacea* (Sol. ex Vahl) Kunth, *Enum. Pl.* 2: 312 (1837). *Cyclocampe arundinacea* (Sol. ex Vahl) Benth. in G.Bentham & J.D.Hooker, *Gen. Pl.* 3: 1063 (1883). *Lophoschoenus arundinaceus* (Sol. ex Vahl) Stapf, *J. Linn. Soc., Bot.* 42: 180 (1914). *Costularia arundinacea* (Sol. ex Vahl) Kük., *Repert. Spec. Nov. Regni Veg.* 44: 185 (1938).

Type citation: 'Schoenus radiatus. *Forst. prodr. n.* 491.' '*Habitat in* nova Caledonia. *Frabricius Professor Kilonensis*.'

Type: 'Habitat in Nova Caledonia' 'Hb. Vahlian. Coll. Forst. ded. Dr. Fabri.' [New Caledonia: Balade, 5–13 Sept. 1774, *J.R. Forster, J.G.A. Forster & A. Sparrman s.n.*] (holotype: C 10010116 [ex Herb. Vahl]*, iso: B W01117-010 [*Willdenow Herbarium No. 1117*]*, BM 000798904*, BM 000798905*, BM 000991058*, BM 000991059*, K 000960113).

Costularia daenikeri Kük., *Repert. Spec. Nov. Regni Veg.* 46: 31 (1939). *Tetraria daenikeri* (Kük.) T.Koyama, *J. Fac. Sci. Univ. Tokyo, Sect. 3, Bot.* 8: 74 (1961).

Type citation: 'Neu-Kaledonien: In grasreichem Gebüsch, auf dem Serpentinblockgrat südöstlich des Mt. Humboldt-Gipfels, XI. 1924 (Däniker n. 552!).

Type: New Caledonia: Mount Humboldt, 7 Nov. 1924, *A.U. Däniker 552* (holotype: B, presumed destroyed; isotypes: P 00607409, fragment*, Z 000005206*).

[*Schoenus arundinaceus* Sol. ex G.Forst., *Fl. Ins. Austr*. 89 (1786), *nom. inval., nom. nud*.; *Schoenus radiatus* J.R.Forst. ex Vahl, *Enum. Pl. Obs.* 2: 220 (1805), *nom. inval., in syn*., *non* L.f. (1782), probably in error for *S. arundinaceus*.]

Illustrations: Brongniart in Duperrey (1833, t. 30); Hooker and Hooker, (1883 t. 1434); Kaphahn (1905; figs 8–10); Clarke (1909; t. 79, figs 1–4); Metcalfe (1971; fig. 48d); Raynal (1974; fig. 7, 1–5); Wulff *et al.* (2010; p. 258, pl., p. 260, pl.).

Perennial tufted herb, 1.5–3.0 m high; plants clonal, with distant culms, clones 0.5–3 m across; rhizome thick, woody, long, branched, 15–20 mm diam., not pseudobulbous; old leaf sheaths covering the rhizome, breaking apart into fine fibres with age, reddish brown to dark brown; roots sand-binding. *Caudex* erect, to 70 cm high, 15–23 mm diam., with a loose rosette of many leaves towards the apex, old leaves persistent below. *Culms* stout, rigid, erect, with 3 or 4 nodes, trigonous, often deeply grooved, 3–7 mm diam., smooth, glabrous, green to yellow-green, base not enlarged. *Leaves* mostly at apex of the caudex, numerous, and 3 or 4 cauline; phyllotaxy loosely spirotristichous; sheath 45–65 mm long, 4–8 mm wide, slightly narrower than the leaf lamina, margins scabrid, otherwise glabrous, pale brown, shiny, upper margin not membranous, truncate, ligule absent; cauline sheath tight around culm; *pseudopetiole* obscure or absent; rosette leaves long, but not exceeding the culms, lamina dorsiventral, 40–100 cm long, 5–10 mm wide; bases not differentiated, not dividing; lamina ± linear, ± V-shaped in section, particularly channelled towards the apex, ± flexuous, old leaf tips not curling, finely multi-striate, lamina glabrous, mostly green but yellow just above the sheath, ± concolorous, not keeled along mid-nerve, margins slightly denticulate and finely scabrous, prominently recurved, apex long-attenuate; lowest leaves not reduced to a sheath. *Inflorescence* elongate, panicle-like, narrow but somewhat spreading, ± erect, with 6–11 nodes, 30–70 cm long, 5–10 cm wide, interrupted, axis green or yellow-green, not glaucous; bracts reduced leaf-like at the base, bract-like with a slender lamina above, not exceeding the branchlets, sheaths open, not enveloping the higher bracts, gradually reducing along the inflorescence, basal bract much or somewhat shorter than inflorescence, 15–50 cm long; basal branchlets 7–20 cm long; branches erect to shortly spreading, elongate, with secondary and tertiary fascicles of branchlets, each with 2–6 spikelets, spikelet(s) solitary or paired on short, compressed, scabrous-margined peduncles 0.5–4.5 mm long, arising in each bract axil; spikelet prophyll present, sheath 1.1–2.0 mm long, brown, midrib distinct, partially enclosing the spikelet, with a slender lamina 0.2–0.6 mm long, brown. *Spikelets* brown, oblate to lanceolate, 4.7–6.6 mm long, subterete, with 6–9 glumes, only topmost 2 fertile, both bisexual, fertile, no reduced glume above the florets; glumes subdistichous, basal glume 1.1–1.9 mm long, fertile glumes 4.1–5.3 mm long, 1.1–1.7 mm wide, membranous, red-brown, glabrous on the keel, margins ciliolate, lamina glabrous, ovate-lanceolate, subacute, with a mucro to 0.5 mm long, keel distinct; rachilla compact and not sinuous in fruiting spikelets. *Perianth segments* 6, whitish, 3.3–4.4 mm long, *c.* twice as long as the nutlet, base not dilated, tapering to a fine point, margins finely and densely scabrous. *Stamens* 3; anther connective 3.4–3.9 mm long, subulate; anthers yellow, 2.3–2.7 mm long, with a glabrous apical appendage up to 0.4 mm long. *Style* trifid, base 3.4–4.1 mm long, slender and glabrous above, dilated and densely scabrous in lower third, branches 1.6–1.9 mm long, hispidulous. *Nutlet* indistinctly stipitate, slightly constricted, obovoid to ellipsoid, obscurely trigonous, dull, mid-brown, 1.3–1.7 mm long including the stipe and persistent portion of the style base, 0.5–0.7 mm diam., faces smooth, puberulous near apex, epidermal cells ± oblong to ovate, inconspicuous, with three fine white ribs, style base slightly enlarged, thick, persistent, shortly conical; embryo not examined. *Photosynthetic pathway* inferred from anatomy to be C_3 (Bruhl & Wilson 2007; *Raynal & Jaffré 16508*). (Figure 12)

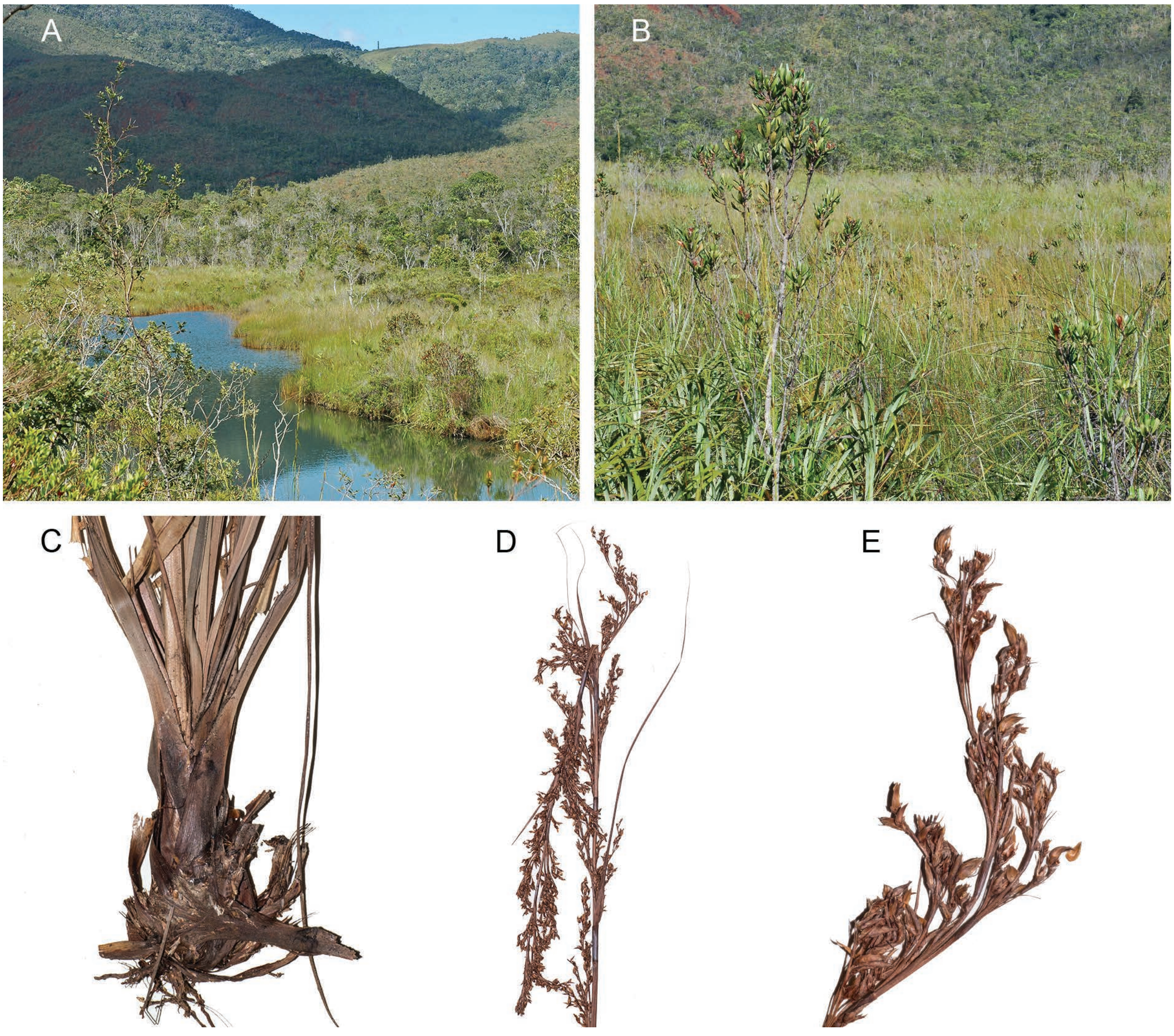

Fig. 12. *Tetraria arundinacea*. A, B. Habitat in maquis zone, Rivier Bleue, New Caledonia. C. Mature plant base. D, E. Inflorescence. C–E from *K.L. Wilson 7085* (NSW). Photos A, B by J. Munzinger; C–E by R.L. Barrett.

Diagnostic characters: Closely related to *Tetraria raynaliana* Larridon (formerly *Costularia pubescens* J.Raynal), which differs in the leaf lamina being ± flat in section (*vs* ± V-shaped); pubescent (*vs* glabrous); leaf margins ciliate (*vs* scabrous); leaf keel pilose (*vs* glabrous); and ciliate perianth segments (*vs* scabrous). *Tetraria sylvestris* (J.Raynal) Larridon (formerly *Costularia sylvestris* J.Raynal), differs in the broader leaves, 15–25 mm wide (*vs* 5–10 mm); leaves ± M-shaped in section (*vs* ± V-shaped); arcuate (*vs* ± erect) inflorescence branches and elongate persistent style base ± as long as the nutlet (*vs* ± 1/4 as long).

Distribution: Endemic to New Caledonia, widespread on the main island, Grande Terre, also on the Isle of Pines and the Bélep Islands.

Habitat: Grows most commonly in maquis, in swamps and wet slopes, but also in *Nothofagus* and *Araucaria* forests, on a variety of ultramafic soil types, commonly on serpentinite, from 50–1500 m altitude (Wulff *et al.* 2010). This species is an important component of many maquis habitat and can be dominant, particularly in disturbed areas such as rehabilitation areas and roadsides (Raynal 1974). Recorded in association with *Actinoschoenus filiformis*, *Araucaria laubenfelsii*, *A. montana*, *Babingtonia leratii*, *Bikkia macrophylla*, *Chorizandra cymbaria*, *Codia discolor*, *Cunonia lenormandii*, *Dracophyllum ramosum*, *D. verticillatum*, *Exocarpos neocaledonicus*, *Fimbristylis dichotoma*, *Gahnia microcarpa*, *G. novocaledonensis*, *Gleichenia dicarpa*, *Hibbertia emarginata*, *Lepidosperma perteres*, *Lycopodium deuterodensum*, *Machaerina deplanchei*, *M. gunnii*, *M. rubiginosa*, *Melaleuca quinquenervia*, *Meterosideros francii*, *M. nitida*, *Nothofagus* sp., *Podocarpus sylvestris*, *Polyscias pancheri*, *Scaevola balanse*, *S. beckii*, *Schoenus neocaledonicus*, *S. tendo*, *Scleria levis*, *Sphenomeris deltoidea*, *Sticherus flabellatus*, *Styphelia cymbulae*, *Symplocus montana*, *Tristaniopsis glauca* and *Wikstroemia indica*.

Phenology: Flowers mainly (April) June–December. Fruits mainly December–April.

Selected specimens and images examined: NEW CALEDONIA: Presqu'île Bogota, 28 June 1914, *R.H. Compton 1343* (BM, NSW); Les Dalmates, tributary of Ya River; road to Yatè and Parc de la Rivière Bleue, 11.3 km NE of turn-off from road to Mt Dore and Plum, 3 Nov. 2003, *D.M. Crayn et al. 755* (NSW); Mount Humboldt, 7 Nov. 1924, *A.U. Däniker 548* (Z*); Tiaré, 1861–1867, *M. Deplanche 240* (Z*); Touho: Tegan, 10 Oct. 1971, *H.S. McKee 24422* (CANB, CHR, *n.v.*, NY, P*, Z*); Pouébo: Mt Mandjela (Exploitation forestière Frouin), 12 Apr. 1972, *H.S. McKee 25211* (BISH*, G, MO, *n.v.*, NOU, *n.v.*, NSW); Touho: Ponandou, 15 June 1974, *H.S. McKee 28844* (CANB); Galarino, 22 July 1974, *H.S. McKee 28916* (NSW); Haute Tiwaka: Hauteurs de Bobetio, 29 July 1976, *H.S. McKee 31661* (NSW); Mont Nakada (Crête Nord-Est), 6 Oct. 1977, *H.S. McKee 33926* (NSW); mine des Thermopylee (6 km WNW of Thio), 1 Oct. 1971, *J. Raynal 16522* (BISH*, CANB, CHR, *n.v.*, NOU, *n.v.*, Z*); Auf den Bergen bei Yaouhé, 22 Sept. 1902, *F.R.R. Schlechter 14765* (NSW, Z*); Auf den Bergen bei Paita, 7 Oct. 1902, *F.R.R. Schlechter 14957* (NSW); Montagne des Sources, Réserve Intégrale, 19 Mar. 1987, *K.L. Wilson 7062* (AD, NSW); 7 km directly WNW of Thio on Do Thio [River], 24 Mar. 1987, *K.L. Wilson & R. Cherry 7113* (NSW); track to summit of Montagne des Sources from car-park, 4 Feb. 1991, *K.L. Wilson 7747* (NSW); Plateau de Dogny, 6 Feb. 1991, *K.L. Wilson 7770* (GENT, NSW, P); Rivière Bleue Provincial Park, 3.7 km NW of Pont Perignon on road to Pont Germain, 12 June 2001, *K.L. Wilson 9935* (NSW); Dôme de Tiébaghi, *c.* 250 m WSW of highest point, *c.* 2 km SSE of old village, 15 Aug. 2001, *K.L. Wilson 9948 & J. Stockard* (NOU, NSW, P).

Conservation: Relatively widespread and locally common, including in several reserves, so not considered threatened. IUCN: Least Concern.

Etymology: Presumably named from the similarity in form of the plant to the grass genus *Arundo* L.

Common name: None known.

Typification: No type was nominated by Hiepko (1969) who simply cited Forster material at B (*Willdenow Herbarium No. 1117*). Hiepko annotated the sheet at B as an isotype. Similarly, Hansen and Wagner (1998) cited the label details of the specimen at C but did not designate a formal status for the specimen. The protologue only matches the specimen at C (C 10010116), based on a stamp 'Hb. Vahlian.' and text 'Coll. Forst. ded. Dr. Fabri.', both absent from the other duplicates, and we therefore accept it as the holotype (Turland *et al.* 2018; Art. 9.1). Johan Christian Fabricius, who was Professor at the University of Kiel, presumbably supplied Vahl with this Forster specimen, now incorporated at C. There are duplicates of this collection at B, BM and K, each with slightly differing labels.

It is debatable whether the text 'Schoenus radiatus. *Forst. prodr. n.* 491.' should be included as indicating type material, however we conclude that only a single collection is involved in any case. We have found only one sheet actually labelled with Forster's Prodr. No. 491, at BM (BM 000991059), a fragment probably taken from the sheet at K (K 000960113).

Notes: The authorship of the name is not obvious as there are at least two options for the appropriate citation. There is no mention of Solander by Vahl (1805: 220), however indirect reference to Solander being the original author of the name is made through the inclusion of the text 'Schoenus radiatus. *Forst. prodr. n.* 491.' This is itself confusing, as No. 491 in Forster (1786: 89) is '*Schoenus arundinaceus* S. Noua Caledonia.' [S. being Solander], but that name is a *nomen nudum*. It appears that 'radiatus' is a typographic error for 'arundinaceus' in this case as Vahl treats *Schoenus radiatus* L.f. on page 260 of the same publication. While the name could be attributed solely to Vahl, we accept the indirect reference to Solander through the citation of Forster (1786) as attribution to Solander, so cite the name here as 'Sol. ex Vahl', which is in keeping with tradition for this name.

A rapid coloniser with high potential for stabilisation of erosion areas and mine site rehabilitation due to rapid and extensive root growth (Gonin *et al*. 2013; Demenois *et al*. 2017). This species is consistently colonised by arbuscular mycorrhiza (Perrier *et al*. 2006).

Däniker (1932: 76) discussed a variant of *Lophoschoenus arundinaceus*, but we include this within the variation of *Tetraria arundinacea*. Kükenthal (1939a) distinguished *Costularia daenikeri* from *C. arundinacea* based on the dilated bases of the perianth segments and the purple-black apex to the glumes. Raynal (1974) concluded that Kükenthal observed immature nutlets, and that these characteristics are not taxonomically significant.

This species is sometimes confused with *Gahnia sieberiana* Kunth due to similarities in plant habit.

Tetraria capillacea (Thunb.) C.B.Clarke, in Durand and Schinz, *Conspect. Fl. Afr.* 5: 659 (1894).

Schoenus capillaceus Thunb., *Prodr.* 16 (1794). *Chaetospora capillacea* (Thunb.) Nees, *Linnaea* 9: 299 (1834).

Type citation: None cited [but by implication from the title of the work: Cape of Good Hope, 1772–1775, *C.P. Thunberg*].

Type: South Africa: e Cap. b. spei. [1772–1775], *C.P. Thunberg s.n.* (holo: UPS (V-001320), *n.v.*; iso: B, *n.v.*, probably destroyed).

Chaetospora flexuosa var. β *gracilis* Boeckeler, *Linnaea* 38: 304 (1874).

Type citation: 'Prom. bon. spei (Bergius, Krebs, Burchell no. 566, n. 8063. B., Mundt. β. Eckl. hb. no. 112. et cum aliis plantis mixt a).'

Type: Table Mountain near Cape Town, [pre 1815], *W.J. Burchell 566* (lectotype (here designated): K 001322023*).

Residual syntypes: South Africa: 'An Fluβufern und steinigen Stellen der Küstenregion von Kapland: Kap Distr., am Tafelberg,' *Bergius s.n.* (syn: ?B, likely destroyed); Caledon Division: Nieuw Kloof, Houw Hoeck Mountains [Houhoekberge], 16 March 1815, *W.J. Burchell 8063* (syn: K 001322021*); Western Cape Division: 1 [Worcester, Waterfall], December, *C.F. Ecklon & C.L.P. Zeyher 1.12* (syn: MEL 2463578); In monte tabulari, 22 Mai 1821, *Krebs s.n.* (syn: K 001322024 (ex B)*); 'Kapland s.l.,' *Mundt* (syn: ?B, likely destroyed).

Tetraria capillacea var. *intercedens* Kük., *Repert. Spec. Nov. Regni Veg.* 29: 189 (1931).

Type citation: 'Koude Rivier (Schlechter Nr. 9739!); Genadental (Schlechter Nr. 9825!).'

Type: Koude Rivier, 243 m, 15 Dec. 1896, *F.R.R. Schlechter 9739* (lectotype (here designated): P 00461878*; isolecto: L 1399045*, P P00461877*, P P00461879*, S 13-18894*, WAG 0108310*).

Residual syntype: SOUTH AFRICA: Worcester District: Genadendal auf Bergen, 1463 m, 23 Dec. 1896, *F.R.R. Schlechter 9825* (G, *n.v.*, L 1399634*, PRE, *n.v.*, S G-6794*, WAG 1777101*, WAG 0389339*).

Chaetospora flexuosa auct. non Schrad.: Drège, *Linnaea* 20: 251 (1847), as to *Ecklon & Zeyher 4437* (P*).

Image: Vánky (2009; fig. 12, smutted).

Perennial tufted herb, 0.3–0.9 m high; plants clonal, compact, clones 0.2–0.6 m across; rhizome thick, woody, short, branched, 5–15 mm diam., non-pseudobulbous; old leaf sheaths covering the rhizome, breaking apart into fine fibres with age, reddish brown to dark brown; roots sand-binding. *Caudex* absent. *Culms* slender, rigid, erect, 30–60 cm long below inflorescence, with 1–3 nodes, terete, finely striate, 1.5–3.1 mm diam., glabrous, green, base not enlarged. *Leaves* mostly basal, numerous, and 1–3 cauline; phyllotaxy loosely spirotristichous; sheath 18–82 mm long, 1.0–1.9 mm wide, broader than the leaf lamina, margins rapidly breaking apart, glabrous, chestnut-brown, shiny, upper margin narrowly membranous, oblique to truncate, ligule absent; cauline sheath tight around culm, dark brown to black; *pseudopetiole* obscure or absent; leaves not exceeding the culms, lamina dorsiventral, 12–48(–75) cm long, 0.5–0.7 mm wide; bases not differentiated; lamina setaceous, ± linear, channelled throughout (± V-shaped in section), ± flexuous, old leaf tips not curling, finely multi-striate, lamina glabrous, green to yellow green, ± concolorous, strongly keeled along mid-nerve, margins very finely scabrous, not recurved to involute, apex long-attenuate; lowest leaves not reduced to a sheath. *Inflorescence* dense but elongate, panicle-like, narrow, ± linear, ± erect, with 4–7(–10) nodes, 6–25 cm long, 0.8–1.5 cm wide, interrupted to ± continuous, axis green to yellow-green, not glaucous; bracts reduced leaf-like at the base, bract-like with a slender lamina above, usually exceeding the branchlets, sheaths open, not enveloping the higher bracts, gradually reducing along the inflorescence, basal bract usually somewhat shorter than or equal to inflorescence, 6.5–21 cm long; basal branchlets 4.6–8.5 cm long, 1 or 2 arising in each bract axil; branches erect, each with 3–5 spikelets, spikelets solitary or appearing paired on compressed, scabrous-margined peduncles 0.5–15 mm long. *Spikelet prophyll present*, sheath 3.3–3.7 mm long, brown, midrib distinct, partially enclosing the spikelet, with a slender lamina 0.3–0.7 mm long, brown. *Spikelets* 25–55 per inflorescence, brown, elliptic to lanceolate, 5.5–10.5 mm long, 1.5–2 mm wide, subterete, 5–9 glumes, only topmost 2(3) fertile, lower flower bisexual, functionally male, upper 1(2) bisexual, fertile, no reduced glume above the florets; glumes distichous, basal glume 2.2–2.8 mm long, fertile glumes 6.0–8.5 mm long, 0.8–1.6 mm wide, membranous, red-brown, glabrous on the keel, margins translucent and minutely ciliate, lamina glabrous to minutely scabrid, ovate, acute, with a mucro to 0.7 mm long, keel distinct only towards the apex; rachilla compact and not sinuous in fruiting spikelets. *Perianth segments* absent or 6, whitish, 0.4–0.6 mm long, *c.* one quarter as long as the nutlet, base not dilated, tapering to a fine point, margins glabrous. *Stamens* 3; anther connective 5.1–7.5 mm long, subulate; anthers yellow, 2.6–2.9 mm long, with a scaberulous apical appendage up to 1.1 mm long. *Style* trifid, base 4.8–5.6 mm long, slender and hispidulous in upper half, slender and glabrous in lower half, branches 1.9–2.5 mm long, hispidulous. *Nutlet* distinctly stipitate, constricted, obovoid to ellipsoid, obscurely trigonous, dull, pale brown, 2.1–3.5 mm long including the stipe and persistent portion of the style base, 1.0–1.5 mm diam., faces ± smooth (can appear finely papillose), glabrous, epidermal cells ± oblong to ovate, inconspicuous, with three fine white ribs, style base slightly enlarged, thick, persistent, shortly pyramidal; embryo Schoenus-type. Photosynthetic pathway not examined. $2n$ = unknown. 1C = 0.29 pg (*Muasya 6467*; Bureš *et al*. 2013). (Figure 13)

Fig. 13. *Tetraria capillacea*. Cape Floristic Region, South Africa (A, C–E, G from Upper Elandspadkloof, Hawekwas Range; B, F from Table Mountain National Park). A. Habitat. B, C. Habit. D. Plant base. E. Inflorescences. F. Inflorescence with stamens. G. Infructescence. Not vouchered. Photos by T. Rebelo. All also posted on iNaturalist.org.

Diagnostic characters: Sister to *T. flexuosa* which differs in having leaves which are plano-convex near their base (*vs* strictly setaceous).

Distribution: Endemic to South Africa. Primarily close to the south coast of South Africa, from Cape Town north to the Winterhoek Mountain area and east to Grahamstown.

Habitat: Grows in fynbos, where it can be a dominant and defining species for some fynbos communities, most commonly on sands and shale or quartz-derived soils, in damp situations, from 90–1700 m altitude. Recorded in association with *Agathosma ovata*, *Brunia nodiflorum*, *Cliffortia ilicifolia*, *C. serpyllifolia*, *C. stricta*, *Colpoon compressa*, *Elegia juncea*, *Erica copiosa*, *E. formosa*, *E. glandulosa*, *E. sessiliflora*, *E. sparsa*, *E. speciosa*, *Ficinia fascicularis*, *Hypodiscus striatus*, *H. synchroolepis*, *Indigofera sulcata*, *Leucadendron eucalyptifolium*, *L. salignum*, *Metalasia gnaphalodes*, *M. muricata*, *Passerina vulgaris*, *Penaea cneorum*, *Priestleya hirsuta*, *Protea cynaroides*, *P. neriifolia*, *Pteridium aquilinum*, *Pterocelastrus tricuspidatus*, *Restio triticeus*, *Schoenus adnatus*, *S. quadrangularis*, *Simocheilus multiflorus*, *Struthiola hirsuta*, *Tetraria involucrata*, *T. secans*, *T. thermalis* and *Virgilia oroboides* (Hanekom *et al*. 1989).

Phenology: Flowers April–December.

Specimens and images examined: SOUTH AFRICA: Cape Province: George District, top of Outeniqua Pass, 3000 ft, 19 Oct. 1953, *R.H. Compton 24401* (P*); Malbrothkloof, 20 Feb. 1828, *J.F. Drège 1634 aa* (P*); Cape Province: Villiersdorp District, Silverstream, farm in Riviersonderend Mountains, 4000 ft, 14 May 1974, *P. Goldblatt 1827* (MO, *n.v.*, NSW, P*); Cape Province: George [District], 200–300 m, 12 Aug. 1933, *H. Humbert 9870* (P*); Camp Berg, 600 ft, 12 Aug. 1946, *M.R. Levyns 7916* (P*); Worcester District, Genadendal, 1500 ft, 2 Apr. 1897, *F.R.R. Schlechter 10307* (L*, NSW, P (3 sheets)*, WAG (2 sheets)*); Caledon District, Domt Neweberg, 3500 ft, 2 Feb. 1962, *H.C. Taylor 3024* (P*, PRE, *n.v.*); Stellenbosch District, Jakkalsvlei, Jonkershoek, 366 m, 7 Apr. 1964, *H.C. Taylor 5732* (PRE*).

Conservation: Relatively widespread in the southern Cape Province and not considered threatened. Conserved in numerous conservation areas including Agulhas National Park, Groenlandberg, Hottentots Holland, Kleinmond and Kogelberg Nature Reserves. IUCN: Least Concern.

Etymology: Based on the Latin *capillaris* (resembling hair), presumably in reference to the fine culms that spread out.

Common name: Ridge Tetrar.

Notes: This taxon may represent a species complex and a detailed taxonomic revision is needed to determine whether additional taxa should be recognised (G.A. Verboom, *pers. comm.*).

No type of *Schoenus capillaceus* was specifically cited by Thunberg (1794:16), but the full title of that work indicates that it is based on specimens collected by Thunberg, so it can be inferred that the type should be a Thunberg specimen. Thunberg's herbarium is in UPS (Forbes 1986) and it contains a specimen labelled as holotype (no image is available online, but it is available on microfiche).

Nees (1835: 192) cited material at B (without any details), a citation simply repeated by Kunth (1837: 325), and Boeckeler (1874: 305) only cited later collections. The specimen cited above at B was seen by Kükenthal prior to 1940, but appears to be no longer extant.

While traditionally included as a synonym of *T. capillacea*, the lectotype and all syntypes of *Chaetospora flexuosa* var. *gracilis* probably apply to *T. flexuosa* (except Bergius, but that specimen appears to have been destroyed). A lectotype has been chosen for *Chaetospora flexuosa* var. *gracilis* which represents the main concept of Boeckeler (1874) and has good material on the sheet, but original material of *T. capillacea* needs to be located, and a revision of the *T. capillacea* and *T. flexuosa* complexes should be undertaken to ensure the correct application of all names in this group. The name is here listed as a synonym following tradition, but this listing is rather notional following the selection of a lectotype.

Kükenthal (1931) appears to have included all syntypes of *Chaetospora flexuosa* var. *gracilis* Boeckeler except for *Ecklon & Zeyher 112* under his concept of *T. capillacea* var. *flexuosa* (Thunb.) Kük. Later, Kükenthal (1940) excluded *Ecklon & Zeyher 112* from his concept of *T. capillacea*, but in this publication, it also becomes apparent that he distinguishes a collection by Bergius as belonging to *T. capillacea*, while assigning another to *T. flexuosa*. Examination of specimens at MEL from the Sonder herbarium showed that at least two species were included under *Ecklon & Zeyher 112* as the number 112 actually represents a location and date (1 for Worcester, Waterfall, and 12 for December), so the same number simply indicates that they co-occurred. Kükenthal may have been looking at another collection that was confused due to the 'collection' number.

The application of *Tetraria capillacea* var. *intercedens* Kük. has not been determined in recent literature (e.g. Archer 2003), but it is here tentatively included as a synonym of *T. capillacea* pending more detailed studies in this complex. A single sheet of *Schlechter 9739* at P (P 00461878) is selected as the lectotype of *Tetraria capillacea* var. *intercedens* Kük. as it has ample material on the sheet.

Tetraria capillacea is the only known host species for the smut fungus *Moreaua capillaceae* Vánky (Vánky 2009).

Tetraria cernua (Levyns) Larridon, *S. Afr. J. Bot.* 118(1): 22 (2018).

Epischoenus cernuus Levyns, *J. S. African Bot.* 25: 80, fig. 4 (1958).

Type: South Africa: Cape Province: Somerset West Division: Steenbras Reservoir, 365 m, 1 May 1948, *M.R. Levyns 8873* (holo: BOL 139407*; iso: B 10 0166692*, BOL 139408*, K 000244899*, M 0107112*, MO 1515490*, NBG 0200373-0*, S G-6800*).

Illustrations: Levyns (1958; fig. 4); Browning and Gordon-Gray (1995; fig. 2).

Perennial tufted herb, 0.3–0.7 m high; plants clonal, forming dense tussocks 0.1–0.2 m across; rhizome thin, woody, short, branched, 1–2 mm diam., non-pseudobulbous; old leaf sheaths covering the rhizome, margins breaking apart into fine fibres with age, open almost to the base, pale brown to dark brown; roots sand-binding. *Caudex* absent. *Culms* 4–20 cm long below the inflorescence, very slender, rigid, erect to spreading, with 0 or 1 node(s), terete, finely striate, 0.5–0.9 mm diam., smooth, glabrous, green, base not enlarged. *Leaves* mostly basal, numerous, none or 1 cauline; phyllotaxy loosely spirotristichous; sheath 25–60(–92) mm long, 0.8–2.0 mm wide, ± equal to the leaf lamina when fresh, margins finely but rapidly breaking apart, glabrous, green to pale brown, dull, upper margin narrowly membranous, oblique, ligule absent; cauline sheath tight around culm, brown to reddish brown; *pseudopetiole* obscure or absent; leaves not exceeding the culms, lamina dorsiventral, 6–25 cm long, 0.8–2.0 mm wide; bases not differentiated; lamina ± linear, channelled throughout (initially almost flat to lunate, then involute and curling so appearing terete in section), ± rigid, drying, curling and becoming wiry by anthesis, then 0.3–1 mm wide, finely multi-striate, lamina glabrous, green, soon drying brown, ± concolorous, keel along mid-nerve not obvious, margins finely scabrous, apex long-attenuate; lowest leaves reduced to a sheath. *Inflorescence* open, elongate, panicle-like, with 1–4 nodes, 6–28 cm long, 1.5–8 cm wide, widely interrupted, axis green, not glaucous; bracts leaf-like at the base, progressively smaller above, greatly exceeding the branchlets, sheaths open, not enveloping the higher bracts, gradually reducing along the inflorescence, basal bract usually ± equal to or exceeding inflorescence, 6–25 cm long; basal branchlets 2.5–4 cm long, capilliform, margins glabrous, 1–4 arising in each bract axil; branches ± arcuate, each with 1 or 2 spikelets, spikelets solitary or appearing paired, ± sessile or with a short peduncle up to 2.5 mm long. *Spikelet prophyll present*, sheath 1.8–2.1 mm long, brown, midrib distinct, partially enclosing the spikelet, with a slender lamina 0.6–1.2 mm long, brown. *Spikelets* 7–12 per inflorescence, pale brown to red-brown, elliptic, 8–15 mm long, 1.1–2.0 mm wide, compressed to subterete, (8)9 glumes, only topmost 2 fertile, lower flower bisexual, functionally male, upper flower bisexual, fertile, with a slender reduced glume above the florets; glumes distichous, basal glume 2.8–3.1 mm long, fertile glumes 8.5–12 mm long, 1.1–1.5 mm wide, membranous, pale brown, glabrous on the keel, margins translucent and glabrous, lamina glabrous, lanceolate, acute to acuminate, mucro indistinct, keel distinct only towards the apex; glumes soon deciduous post fruiting; rachilla compact and not sinuous in fruiting spikelets. *Suprafloral axis* and rudimentary glume present, shorter than the ovary, often minute, axis free from the glume. *Perianth segments* not seen, probably absent or possibly minute. *Stamens* 3; anther connective 6.1–8.5 mm long, subulate; anthers yellow, *c.* 2.5 mm long, with a glabrous apical appendage up to 0.9 mm long. *Style* trifid, base 2.7–3.1 mm long, slender throughout, hispidulous towards the apex, branches 3.9–4.3 mm long, hispidulous. *Nutlet* distinctly stipitate, constricted, obloid to obovoid, obscurely trigonous, dull, pale brown, 1.8–2.9 mm long including the stipe and persistent portion of the style base, 1.2–1.4 mm diam., faces prominently tuberculate in the upper third with a ring of hairs at the base of the style, rugulose-tuberculate to almost smooth below, epidermal cells ± oblong to ovate, inconspicuous, with three fine white ribs, style base not or only slightly enlarged, not persistent; embryo not examined. *Photosynthetic pathway* inferred from anatomy to be C_3 (Bruhl & Wilson 2007; *Levyns 8873*). *2n* = unknown. (Figure 14)

Diagnostic characters: The small suprafloral axis and rudimentary bract are not known in any other species of *Tetraria*. The bright green culms, lax habit, and relatively few spikelets on long peduncles also give this species a distinctive appearance.

Distribution: Endemic to South Africa. Recorded in the Caledon, Clanwiliam, Ceres, Paarl, Stellenbosch, Tulbagh and Worcester Districts.

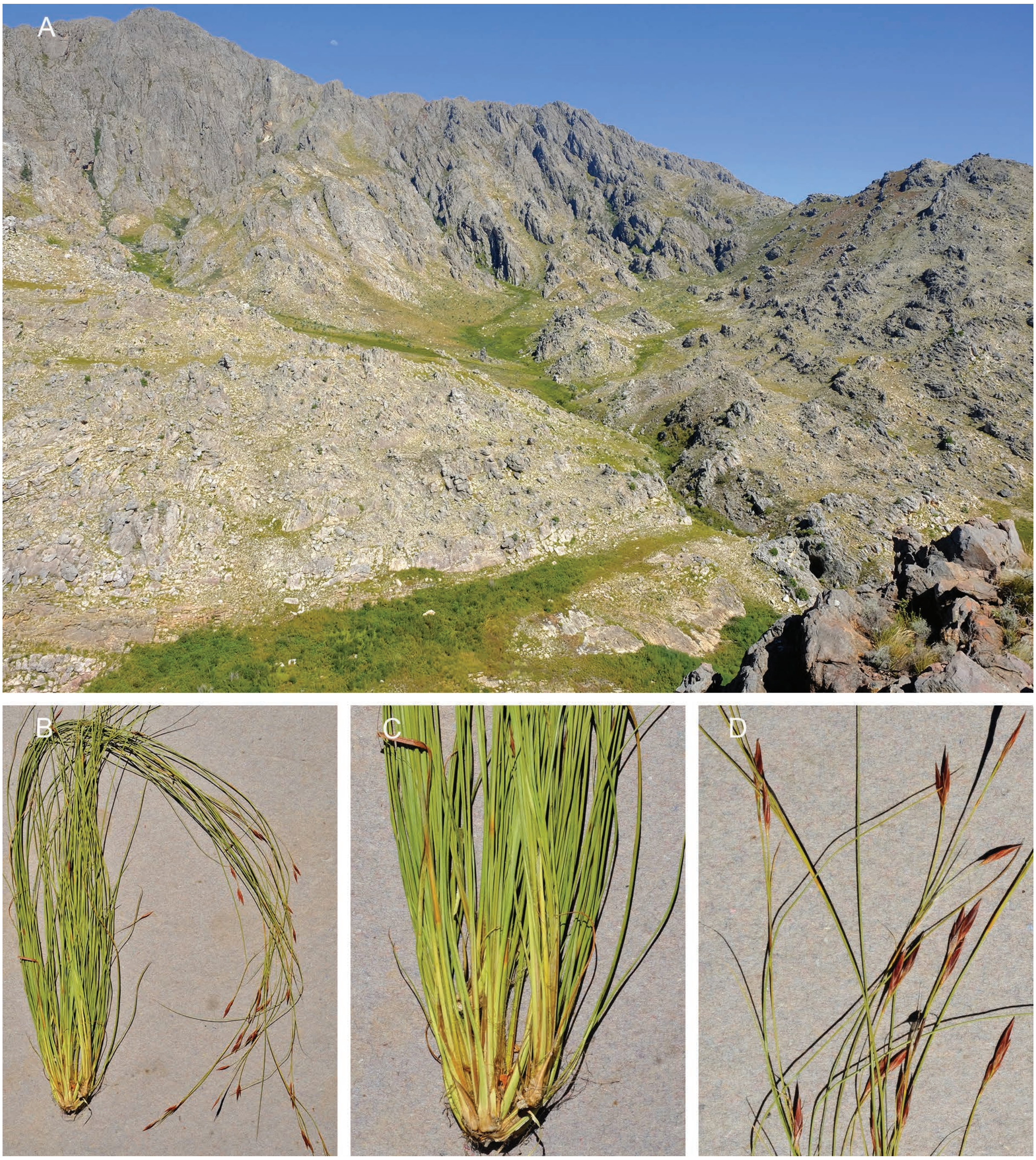

Fig. 14. *Tetraria cernua*. Visgat area, Witsenberg Mountains, Cape Floristic Region, South Africa. A. Habitat in seepage areas in valleys. B. Whole plant. C. Plant base. D. Inflorescences. From *N.A. Helme 9511* (NBG). Photos by N.A. Helme. B–D also posted on iNaturalist.org.

Habitat: Damp sandy and quartzitic soils in seasonally swampy areas that dry out over summer, from 180–1,530 m altitude. Recorded in association with *Agathosma marifolia*, *Anthospermum galioides* subsp. *galioides*, *Aspalanthus acidota*, *A. bracteata*, *Asparagus suaveolens*, *Babiana mucronata* var. *mucronata*, *Calopsis paniculata*, *Ehrharta calycina*, *Elegia capensis*, *Elytropappus adpressus*, *Eriocephalus africanus* var. *paniculatus*, *Geissorhiza confusa*, *Ischyrolepis gaudichaudiana*, *I. sieberi*, *Leucadendron salignum*, *Metalasia fastigiata*, *Paranomus bracteolaris*, *Passerina truncata* subsp. *truncata*, *Phylica oleaefolia*, *Restio perplexus*, *Romulea hirta*, *R. luteoflora*, *R. saxatilis*, *Serruria aitonii*, *S. cygnea*, *S. effusa*, *Stoebe plumosa* and *Stachys linearis* (Rebelo *et al*. 2006).

Phenology: Flowers May–November.

Specimens and images examined: SOUTH AFRICA: Clanwilliam Division: Southern Cederberg, above Krom River Kloof, 11 Dec. 1950, *E.E. Esterhuysen 17982* (BOL, *n.v.*, PRE*); Jonkersberg: Outeniqua Mountains, lower southern slopes of Engelseberg, 30 Apr. 1986, *J.H.J. Vlok 1471* (PRE, *n.v.*, WAG*).

Conservation: Somewhat restricted in distribution, with a north-south distribution of *c.* 250 km. Relatively poorly collected and in need of a detailed conservation assessment. Protected in the Cederberg and Grootwinterhoek Wilderness Areas, Groenlandberg and Haweqwa Nature Reserves, but area of extent is probably limited by relatively specific habitat requirements.

Etymology: Named from the Latin *cernuus* (inclined, stooping, nodding) in reference to the spikelets that are nodding on thin, arcuate branchlets and peduncles.

Common name: Nodding Tetrar.

Notes: The description is modified from Levyns (1958) as only specimen images and photographs of living material were examined. While included in *Epischoenus* C.B.Clarke by Levyns (1958), a possible relationship with *Tetraria* was noted at the time as it was considered somewhat intermediate between *Epischoenus* and *Tetraria*. All other *Epischoenus* species were transferred to *Schoenus* by Elliott and Muasya (2017), a relationship strongly suggested by the anatomical studies of Browning and Gordon-Gray (1995a, 1995b). The unusual morphology of *Epischoenus cernuus* was also noted by Larridon *et al.* (2018b) when they transferred this species to *Tetraria*.

Tetraria thermalis (L.) C.B.Clarke in T.Durand & Schinz, *Consp. Fl. Afr.* 5: 663 (1894).

Schoenus thermalis L., *Mant. Pl. Altera* 179 (1771). *Lepidosperma thermale* (L.) Schrad., *Gött. Gel. Anz.* 1821(3): 2070 (Tetrariae sp.), t. 4, fig. 5 (1821). *Trichoballia thermalis* (L.) C.Presl, *Symb. Bot.* 1: 9 (1830). *Sclerochaetium thermale* (L.) Nees, *Linnaea* 7(4): 512 (1832).

Type citation: '*Habitat ad aquas calidas* Capitis b. spei, *juxa montes nigros*.'

Neotype: [South Africa], Western Cape, Caledon district, Kogelberg Research Site, 7 Sep 1976, *B.J. Durand 149* (neo: PRE 0516510-0*; isoneo: NBG, *n.v.*), designated by C.Archer in S.Cafferty & C.E.Jarvis, *Taxon* 53: 180 (2004).

Sclerochaetium giganteum Steud., *Syn. Pl. Glumac.* 2(8–9): 159 (1855).

Type citation: 'Hrbr. *Drege* nr. 3965. c. sine nomine. Afr. austr.'

Type: South Africa: Cape Province: Zwischen Sparrbosch und Trado [between Sparrbosch and Trado], 1000–2000 Fuss [ft], July, *J.F. Drège 3965* (holo: P 00461932*; iso: MEL 2463532, MO 2395602*, MO 2395604*, S G-6790*).

Illustrations: Rottbøll (1773; t. 18, fig. 2); Clarke (1909; t. 91, figs 4–7); Marloth (1915: 45, t. 10 fig. A; 39, figs 5–10); Schrader (1821; t. 4, fig. 5); Schönland (1922; 61, t. 68); Metcalfe (1971; fig. 64a–d, f).

Perennial tufted, 'woody' herb, 0.9–2.5 m high; plants clonal, forming dense tussocks 0.4–2 m across; rhizome thick, woody, long, spreading, branched, 20–45 mm diam., somewhat-pseudobulbous; old leaf sheaths covering the rhizome, breaking apart into fine fibres with age only at the very base, dark brown to almost black; roots sand-binding, thick. *Culms* robust, rigid, erect, with 2–5 nodes, trigonous, finely striate, 4–8 mm diam., smooth, glabrous, green to yellow-green, base not enlarged. *Leaves* mostly basal, numerous, and 2–5 cauline; phyllotaxy loosely spirotristichous; sheath 52–80 mm long, 5–10 mm wide, narrower than the leaf lamina, margins scabrid, otherwise glabrous, dark red-brown to dark brown, dull, upper margin firm, oblique, glabrous, ligule absent; cauline sheath tight around culm; *pseudopetiole* obscure or absent; basal leaves large, but not exceeding the culms, lamina dorsiventral, 17–40(–80) cm long, 10–24 mm wide; bases brown, not dividing; lamina ± linear, ± flat to broadly V-shaped, ± flexuous, old leaf tips not curling, finely multi-striate, glabrous, green to yellow-green, strongly discolorous, weakly to strongly keeled along mid-nerve, margins scabrous, not recurved, apex long-attenuate; lowest leaves not reduced to a sheath. *Inflorescence* elongate or contracted, panicle-like, narrow, mostly erect but somewhat nodding at the apex, with (5–)6–10 nodes, 17–80 cm long, 25–50 mm wide, interrupted, axis green or yellow-green, not glaucous; bracts reduced leaf-like, just exceeding the spikelet clusters, sheaths open, not enveloping the higher bracts, gradually reducing along the inflorescence, basal bract much shorter than inflorescence, to 16 cm long; branches 1 per node, erect, with 2–6 spikelets per cluster, spikelet clusters 40–95 mm long, on short peduncles 1–3.5 mm long, fused within the base of each bract, spikelets ± sessile; 150–350 spikelets per inflorescence; lowest branch 3.5–7 cm long; spikelet prophyll present, sheath 13–16 mm long, brown, with distinct midrib, partially enclosing the spikelet, with a slender lamina 6–7.5 mm long, brown to dark brown. *Spikelets* brown to dark brown, ovate, 16–25 mm long, ± terete to greatly compressed, with 8 or 9 glumes, only topmost 3 fertile, the lower flower bisexual but functionally male, fertile, the upper 1 or 2 flowers bisexual, fertile, no reduced glume above the florets; glumes subdistichous, basal glume 12–15 mm long, fertile glumes 12–15 mm long, 2.1–3.5 mm wide, membranous, dark red-brown to dark brown, lamina glabrous below, finely puberulous in upper half, ovate-lanceolate, long-acuminate, with a mucro 5–12 mm long, keel weakly distinct, margins glabrous to minutely ciliate; rachilla compact and not sinuous in fruiting spikelets. *Perianth segments* 6 (apparently sometimes absent), white, 3–5 mm long, not expanded below, subulate, densely covered in long, stiff hairs, almost plumose. *Stamens* 3; anther connective 12–16 mm long, subulate; anthers yellow, 3.4–3.8 mm long, with a glabrous apical appendage up to 0.7 mm long. *Style* trifid or quadrifid, base 7.5–9 mm long, glabrous at the base, but finely hispidulous for most of length, slender above, not or scarcely dilated below, branches 8–10 mm long, hispidulous. *Nutlet* prominently stipitate, stipe 3.5–4.1 mm long, constricted, ovoid to broad-ellipsoid, obscurely trigonous, dull, dark brown, 9–11 mm long including the stipe and style base, 4.1–4.5 mm diam., faces smooth, glabrous, epidermal cells irregular-oblong, inconspicuous, with three fine white ribs, style base slightly enlarged, thick, scabrous, persistent, ovoid when young, forming a small cap or shortly conical to 1.3 mm long when mature; embryo Schoenus-type. Photosynthetic pathway not examined. $2n$ = unknown. 1C = 0.40 pg (*JAR02E*; Bureš *et al*. 2013). (Figure 15)

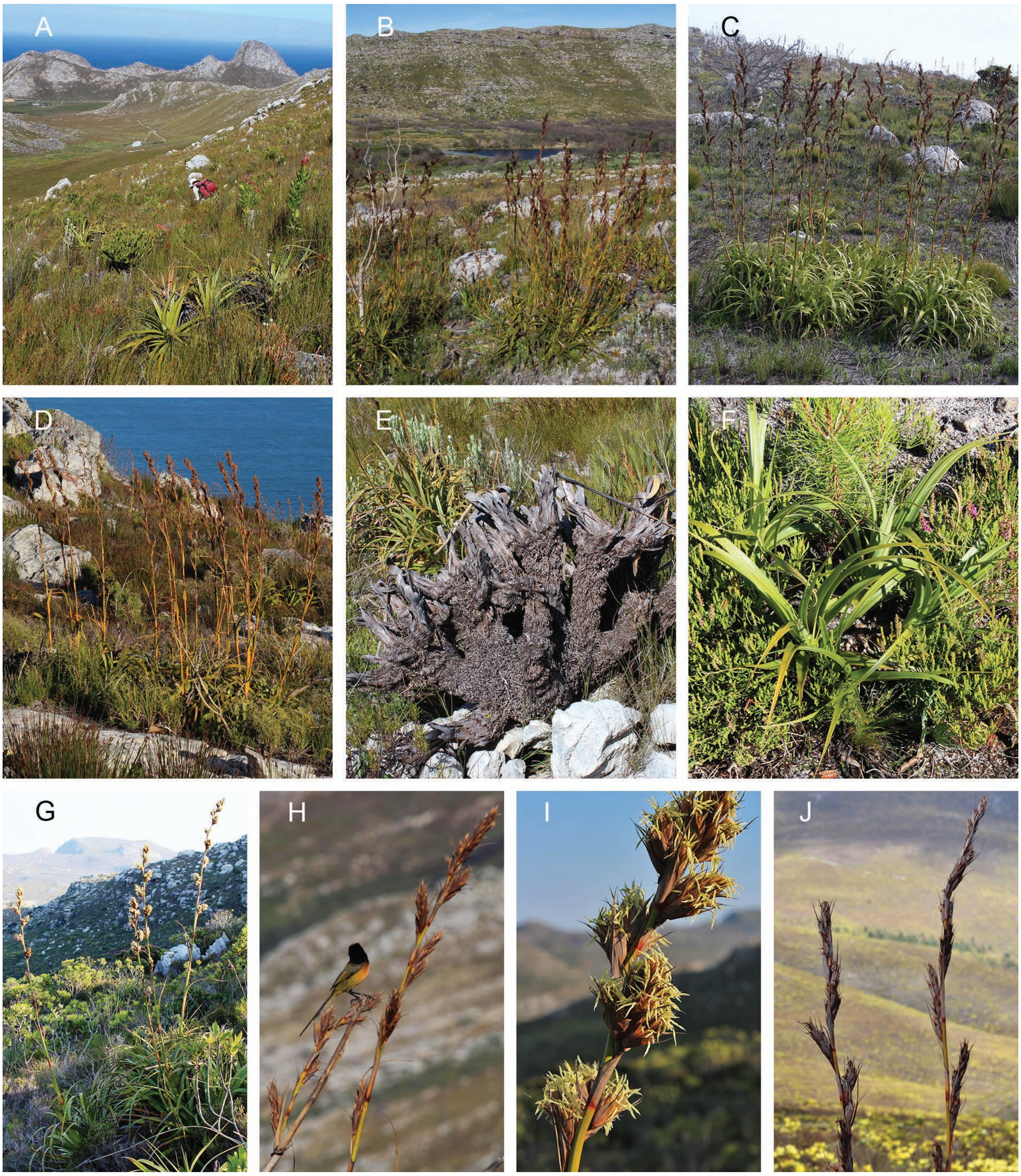

Fig. 15. *Tetraria thermalis*. Cape Floristic Region, South Africa (A, E, F from Higher Hottentots Holland, Kogelberg; B–D, G–I from Silvermine Nature Reserve, Table Mountain National Park; J from Hermanus). A–D. Habit and habitat. E. Branched caudex post-fire. F. Resprouting leaves showing ± three-ranked arrangement. G. Flowering plant. H–J. Inflorescences. Not vouchered. Photos by T. Rebelo. All also posted on iNaturalist.org.

Diagnostic characters: The large stature and spikelets distinguish *T. thermalis* from other members of the genus. Sister to *T. eximia*, which differs in being a smaller plant with more slender leaves (5–8 *vs* 10–20 mm wide) and scabrous hairs (*vs* long stiff hairs) on the perianth segments.

Distribution: Endemic to South Africa. Common in the Western Cape Province, from Cape Town east to the Mossel Bay district.

Habitat: Occurs in a range of fynbos communities, especially on sandstone derived sands. Recorded in association with *Agathosma serpyllacea*, *Aspalathus elliptica*, *A. ramulosa*, *Brunia laevis*, *Calopsis hyalina*, *C. membranacea*, *Cliffortia ferruginea*, *Cyathocoma hexandra*, *Edmondia sesamoides*, *Elegia deusta*, *E. filacea*, *E. juncea*, *E. persistens*, *E. recta*, *E. tectorum*, *Erica globiceps* subsp. *globiceps*, *E. pulchella*, *Ficinia tristachya*, *Geissorhiza hesperanthoides*, *G. hispidula*, *G. juncea*, *G. parva*, *G. schinzii*, *G. similis*, *Hypodiscus argenteus*, *Ischyrolepis capensis*, *Lanaria lanata*, *Leucadendron salignum*, *L. gandogeri*, *Mastersiella digitata*, *Metalasia brevifolia*, *M. erubescens*, *M. inversa*, *Mimetes cucullatus*, *Passerina truncata* subsp. *monticola*, *Phaenocoma prolifera*, *Protea compacta*, *P. repens*, *Restio similis*, *Retzia capensis*, *Rhodocoma fruticosa*, *Romulea dichotoma*, *R. gracillima*, *R. triflora*, *Roridula gorgonias*, *Serruria elongata*, *S. fasciflora*, *S. heterophylla*, *Stoebe aethiopica*, *Tetraria bromoides*, *T. capillacea*, *T. compar*, *T. cuspidata*, *T. fasciata*, *Thamnochortus erectus*, *T. guthrieae* and *Zyrphelis lasiocarpa* (Rebelo *et al.* 2006).

Phenology: Flowers June–October.

Specimens and images examined: SOUTH AFRICA: 56 [=Stellenbosch, Grietjesgat (=Grabouw), between Lowry's Pass and Palmiet Rivier], June, *C.F. Ecklon & C.L.P. Zeyher 111* (FI, MEL, MO*); 58.8 [=Caledon, Kleinriviersberg (=Kleinriviersberge)], Aug., *C.F. Ecklon & C.L.P. Zeyher 4439* (FI, MEL, Z*); Caledon, Aug. 1912, *F.A. Rogers 11138* (Z*); Koude Rivier, 800 ft, 15 [?July] Dec. 1896, *R. Schlechter 9731* (B, *n.v.*, NSW, Z*); Tafelberg bei Kapstadt, 24–25 Sept. 1926, *C. Schröter s.n.* (ZT-00036485*); Swellendam District, Swellendam Forest Reserve, below Eleven O'clock Peak, 610 m, 11 May 1963, *H.C. Taylor 4760* (PRE*); location, date and collector unknown (LINN HL68-16*).

Conservation: Widespread and not considered threatened. Conserved in numerous reserves including Agulhas National Park, Boosmansbos Wilderness Area, Doring River Wilderness Area, Fernkloof, Babilonstoring, Caledon, Heuningberg, Maanschynkop, Ruitersbos, Salmonsdam and Witfontein Nature Reserves. IUCN: Least Concern.

Etymology: Based on the Ancient Greek *thérmē* (heat) in reference to a mistaken belief by Linnaeus that the species grew near thermal springs (Linneaus 1771).

Common name: Bergpalmiet or Berg Palmiet.

Notes: The single sheet of *Schoenus thermalis* at LINN (HL68-16) has no details to identify the collector or year, so it cannot be established whether it is pre- or post-Linnean. While it is a possible syntype, a neotype has been designated to ensure there is no confusion over the application of this name (Cafferty and Jarvis 2004). The LINN specimen lacks leaves, which were described in detail by Linnaeus (1771), so different or additional material must have been available for description.

The nutlets are sufficiently large to be an attractive food for the Chacma Baboon (*Papio ursinus* (Kerr)), and baboons also eat the plant bases (Davidge 1978).

Despite the large inflorescences produced in this species, the equally large rhizomes have sufficient reserves to generate flowering inflorescences within two years of fire, sometimes in as little as 14 months (T. Rebelo, pers. comm.).

Tricostularia Nees ex Lehm., *Nov. Stirp. Pug.* 8: 50 (1844).

Type species: *Tricostularia compressa* Nees ex Lehm.

Discopodium Steud., *Syn. Pl. Glum.* 2(8–9): 150 (1855), *nom. illeg., nom. superfl.*, *non*. Hochst. (1844).

Type species: *Discopodium drummondii* Steud.

Perennial tufted herb, 0.1–0.9(–1) m high; plants clonal, usually forming dense tussocks 0.1–0.6 m across; rhizome thin, woody, short, branched, 0.7–2.1 mm diam., non-pseudobulbous; old leaf sheaths covering the rhizome, usually not breaking apart into fine fibres with age, pale to reddish brown; roots sand-binding. *Culms* slender, rigid, erect to spreading, spirally curved in *T. aphylla*, sometimes arcuate, not or with 1–5 nodes, terete or compressed in *T. aphylla*, not or finely striate, 0.3–3.3 mm diam., smooth, glabrous, green to yellow-green, base not enlarged. *Leaves* mostly basal, numerous, and sometimes 1–5 cauline; phyllotaxy loosely spirotristichous; sheath 9–100 mm long, 0.5–3.5 mm wide, slightly broader than the leaf lamina, glabrous except margins glabrous or scabrid, straw-coloured to dark red-brown, dull, upper margin membranous, oblique, usually finely ciliate, ligule absent; cauline sheath usually tight around culm (loose in *T. sandifordiana*); *pseudopetiole* absent, obscure or rarely distinct; basal leaves often with a much reduced lamina, not exceeding the culms, lamina dorsiventral, 0.5–12.5 cm long, 0.3–1.1 mm wide; bases white or brown-membranous, not dividing; lamina ± linear, channelled, ± flexuous, old leaf tips not curling, finely multi-striate, glabrous except for margins, green to brown, concolorous, keeled along mid-nerve or not, sometimes with 3 primary impressed nerves, margins sometimes ribbed and finely scabrous, not recurved, apex long-attenuate, setaceous; lowest leaves reduced to a sheath, lacking a lamina, pale to reddish brown. *Inflorescence* slender or contracted, panicle-like or subcapitate, straight to somewhat flexuous, not or with 1–9 nodes, 0.7–9.0 cm long, 3–17 mm wide, usually not interrupted, axis green or yellow-green, not glaucous; bracts reduced leaf-like, rarely almost pungent, not or exceeding the spikelet clusters in length, sheaths in the lower part of the inflorescence open, not or sometimes enveloping the higher bracts, gradually reducing along the inflorescence, basal bract somewhat shorter than or sometimes exceeding inflorescence, to 15 mm long; branches erect, with solitary or 2–7 spikelets, usually in a terminal cluster (rarely with a second distant cluster), spikelet(s) on short, terete, glabrous peduncles 0.2–4 mm long, arising in each bract axil; spikelet prophyll present, sheath 0.5–7 mm long, brown, with 1 or 3 distinct veins, partially enclosing the spikelet, with a slender lamina 0.6–2.5 mm long, brown. *Spikelets* brown, lanceolate to oblate, 2.8–10 mm long, terete, with 4–7(–9) glumes, only topmost 2 or 3 fertile, the lower 1 or 2 flowers male, sterile or bisexual, the upper flower bisexual, fertile, no reduced glume above the florets; glumes distichous or subdistichous, basal glume 1.4–4.5 mm long, fertile glumes 2.9–9.8 mm long, 0.7–2.8 mm wide, membranous, very pale red-brown (sometimes translucent) to very dark red-brown (apex often darker than body), often sparsely scabrous on the keel, usually ciliate on the margins, face glabrous, ovate-lanceolate, acute to acuminate or obtuse, with a mucro 0.1–1.2 mm long, keel distinct; rachilla compact and not sinuous in fruiting spikelets. *Perianth segments* 6 (rarely fewer), whitish, minute, 0.2–1.2 mm long, usually unequal, commonly expanded at base, tapering to a fine point. *Stamens* 3; anther connective 2.3–6.9 mm long, subulate; anthers yellow, pale yellow, or cream, 1.4–4.6 mm long, with a glabrous apical appendage 0.15–0.9 mm long. *Style* trifid, base 0.5–3.5 mm long, usually glabrous, sometimes hispidulous, slender above, not or scarcely dilated below, branches 1.3–3.7 mm long, hispidulous. *Nutlet* shortly stipitate, stipe 0.4–0.5 mm long, somewhat constricted, obovoid to obpyriform or broad ellipsoid, obscurely trigonous, dull, mid-brown to dark brown or almost black, 1.2–2.5 mm long including the stipe and style base, 0.8–1.5 mm diam., faces smooth, usually puberulous especially near apex, sometimes hispidulous or glabrous, epidermal cells usually square–hexagonal, inconspicuous, with three fine white ribs, style base only slightly enlarged, thick, persistent, and very shortly conical or thin and cap-like; embryo not assessed, but probably Schoenus-type. Photosynthetic pathway inferred from anatomy to be C_3 (based on three species assessed).

Diagnostic characters: Related to *Chaetospora*, differing in the non-pseudobulbous bases (*vs* not or scarcely pseudobulbous); commonly (but not exclusively) noded culms (*vs* not noded); bract-like inflorescence bracts (*vs* leaf-like); and commonly (but not exclusively) elongate inflorescences (*vs* head-like or elongate-head-like).

Distribution: Endemic to southern Australia, one species in eastern Australia, fourteen endemic to southern Western Australia. There appears to be an unusual concentration of species occurring in the Cape Riche area.

Etymology: Based on the Latin compound *tri-* (three) and *costula* (small rib), presumably in reference to the 3-ribbed fruits.

Notes: The broader definition of the genus used by authors such as Wilson (1993, 1994) and Liang *et al*. (2010) has been shown to be untenable, with several species removed to *Anthelepis* (Barrett *et al*. 2019) and we here return to the generic concept of Kükenthal (1944), but with a larger number of species recognised.

A preliminary key to species is presented here that includes four putative additional taxa that require further taxonomic study to determine their status.

Key to species of *Tricostularia*

1. Culms strongly compressed, ± flattened, 1.2–3.2 mm wide 2

1: Culms terete to compressed and oval (can be oval in *T. compressa* and *T. davisii*); 0.4–2.0 mm diam. 3

2. Culms 1.9–3.2 mm wide, strongly spirally twisted; inflorescence 4.5–9 cm long; spikelets 4.7–7.2 mm long; fertile glumes acute........ ***T. aphylla***

2: Culms 1.2–1.9 mm wide, weakly but still distinctly twisted; inflorescence 9–13 cm long; spikelets 7–9 mm long; fertile glumes ± acuminate .... ***T.* sp. Porongurup (I. Abbott 18)**

3. Inflorescence with 1–3 spikelets; anthers 1.4–1.6 mm long, with an apical appendage ≤0.2 mm long (eastern Australia) .... ***T. pauciflora***

3: Inflorescence with >5 spikelets ; anthers 1.5–4.6 mm long, with apical appendage 0.3–1.2 mm long (Western Australia) 4

4. Culms not noded (or occasionally some culms with 1 node mixed with not noded culms in the same individual) below inflorescence 5

4: Culms consistently with 1–5 nodes below inflorescence 8

5. Inflorescence shortly but obviously oblong, *c.* 1.2–3.5 cm long; to about 4 times as long as wide 6

5: Inflorescence subcapitate, *c.* 0.7–1.1 cm long; to about twice as long as wide; fertile glumes pale to mid yellow-brown, acuminate 7

6. Fertile glumes pale to mid yellow-brown, acuminate .... ***T. neesii*** (typical form)

6: Fertile glumes mid to dark red-brown, obtuse to acute .... ***T. compressa***

7. Culms 15–35 cm tall, in ± distant clusters on linear rhizomes (Lake King region) .... ***T. lepschii***

7: Culms 30–50 cm tall, compact on irregularly branching rhizomes (Mogumber region) .... ***T.* sp. Mogumber (A. Harris s.n., 23/12/2015)**

8. Leaf sheaths flared strongly at the apex; culms with 2–5 nodes, distant on rhizome .... ***T. sandifordiana***

8: Leaf sheaths not flared at the apex; culms with 1–2 nodes, close together on rhizome 9

9. Inflorescence subcapitate to obconical, *c.* 0.7–2.2 cm long 10

9: Inflorescence elongate and linear to narrow-oblong or narrow-obconical in outline, 1.5–12 cm long 12

10. Fertile glumes 3.2–4.2 mm long, with rigid cilia (0.1–0.2 mm long, regularly antrorse) near apex and on midrib; culms 0.3–0.8 mm diam. .... ***T. davisii***

10: Fertile glumes (3.7–)4.7–5.8 mm long, with minute fine cilia (*c.* 0.05 mm long, variably antrorse to widely spreading) near apex and occasionally on midrib; culms 0.5–1.5 mm diam. 11

11. Lower (sterile) glumes 2.2–2.7 mm long; nutlet 1.2–1.5 mm long .... ***T. bennettiana***

11: Lower (sterile) glumes 3.6–4.5 mm long; nutlet 1.9–2.2 mm long .... ***T. neesii***

12. Inflorescence (6–)8–12 cm long; fertile glumes 6–8.8 mm long 13

12: Inflorescence 1.5–8 cm long; fertile glumes 3–5.8 mm long 14

13. Culms 1.1–2.0 mm diam.; clusters of spikelets all partly to strongly overlapping; fertile glumes 7–8.8 mm long .... ***T. exsul***

13: Culms 0.6–1 mm diam.; clusters of spikelets distant or partly overlapping; fertile glumes *c.* 6–7 mm long .... ***T.* sp. Two Peoples Bay (G. Wardell-Johnson GWJ 114)**

14. Inflorescence narrow-oblong or narrow-obconical, dense, with spikelet clusters ± overlapping 15

14: Inflorescence elongate and linear, with spikelets nor or scarcely overlapping 16

15. Culms 10–30 cm tall; fertile glumes 3.7–4.9(–5.6) mm long .... ***T. bennettiana***

15: Culms (35–)45–80 cm tall; fertile glumes 4.7–5.8 mm long .... ***T. neesii***

16: Subtending bracts shorter than or equalling spikelet clusters and therefore inconspicuous .... ***T. newbeyi***

16. Subtending bracts at least slightly exceeding spikelet clusters and obvious 17

17. Inflorescence 3–5 cm long; fertile glumes *c.* 3 mm long .... ***T. drummondii***

17: Inflorescence 5–8 cm long; fertile glumes *c.* 5 mm long .... ***T.* sp. Albany (R.L. Barrett & K.L. Wilson RLB 5342)**

Tricostularia aphylla (R.Br.) K.L.Wilson & R.L.Barrett, *Austral. Syst. Bot.* 25: 286 (2012).

Lepidosperma aphyllum R.Br., *Prodr.* 235 (1810) (as '*aphylla*').

Type citation: "(M.) v.v."

Type: WESTERN AUSTRALIA: Bay I, South Coast [Lucky Bay, E of Esperance Bay], Jan. 1802, *R. Brown* [*Bennett No. 6028*] (holo: BM 000991101; iso: BM 000991102, K).

Perennial tufted herb, 0.3–0.6 m high; plants clonal, forming spreading tussocks 0.1–0.3 m across; rhizome thin, woody, short, branched, 1.6–2.1 mm diam., not pseudobulbous; old leaf sheaths covering the rhizome, not or partly breaking apart into fine fibres with age, pale brown; roots sand-binding. *Culms* stout, rigid, spreading or sometimes erect, commonly spiralling, but sometimes almost straight, with 1–2(–3) nodes strongly compressed, flat on one surface, slightly convex on the other, irregularly so towards the apex, finely striate, 1.9–3.2 mm diam., smooth, glabrous, bright light green to yellow-green, base not enlarged. *Leaves* highly reduced, 1–2(–3) cauline; phyllotaxy loosely spirotristichous; sheath 16–31 mm long, 2.1–3.4 mm wide, slightly broader than the leaf lamina, margins finely ciliate, otherwise glabrous, straw-coloured to brown, dull, upper margin firm, oblique, finely ciliate, ligule absent; cauline sheath tight around culm; *pseudopetiole* obscure or absent; basal leaves few, with only a residual lamina, much shorter than the culms, lamina dorsiventral, 0.6–1.5(–2.4) cm long, 0.7–1.1 mm wide; bases not differentiated, not dividing; lamina ± linear, ± flat to shallowly channelled, ± flexuous, old leaf tips not curling, finely multi-striate, margins very finely scabrid, otherwise glabrous, green, concolorous, slightly keeled along mid-nerve, margins not ribbed, finely scabrous, not recurved, apex long-attenuate; lowest leaves reduced to a sheath, sometimes lacking a lamina, pale brown to brown. *Inflorescence* panicle-like, narrow, linear, somewhat flexuous but ± erect, with 4–9 nodes, 4.5–9 cm long, 3–9 mm wide, usually not interrupted, axis green or yellow-green, not glaucous; bracts reduced leaf-like, not exceeding the spikelet clusters, sheaths open, not enveloping the higher bracts, gradually reducing along the inflorescence, basal bract much shorter than inflorescence, 9.5–16 mm long; branches erect, with (2–)3–7 spikelets per elongate branchlet; basal branchlet 10–26 mm long; spikelet(s) on short, irregularly-compressed, sparsely scabrous peduncles 1.5–4 mm long, arising in each bract axil; spikelet prophyll present, sheath 3.0–3.3 mm long, brown, with 3 distinct veins, partially enclosing the spikelet, with a slender lamina 0.9–2.2 mm long, brown. *Spikelets* brown, lanceolate, 4.7–7.2 mm long, 1.7–2.4 mm wide, ± terete to somewhat compressed, with (5–)7 glumes, only topmost 2 or 3 fertile, the lower 1 or 2 flowers male fertile, the upper flower bisexual, fertile, no reduced glume above the florets; glumes subdistichous, basal glume 2.7–3.1 mm long, fertile glumes 4.5–7.0 mm long, 1.5–2.2 mm wide, membranous, very pale red-brown to red-brown, lamina and keel glabrous, ovate-lanceolate, acute, not mucronate, keel weakly distinct, margins somewhat translucent and very finely ciliate; rachilla compact and not sinuous in fruiting spikelets. *Perianth segments* 6, whitish, 0.8–1.0 mm long, narrowly triangular, flattened, margins ciliate. *Stamens* 3; anther connective 5.1–6.9 mm long, subulate; anthers pale yellow, 2.0–4.0 mm long, 0.3–0.4 mm wide, with a glabrous apical appendage 0.2–0.5 mm long. *Pollen* c. triangular-pyramidal in outline, *c.* 0.025 mm long. *Style* trifid, base 1.9–2.7 mm long, hispidulous and slender above, glabrous and not or scarcely dilated below, branches 2.7–3.7 mm long, papillose-hispidulous. *Nutlet* shortly stipitate, stipe *c.* 0.5 mm long, constricted, obovoid or broad ellipsoid, obscurely trigonous, dull, mid-brown, 2.2–2.4 mm long including the stipe and style base, *c.* 1.3 mm diam., faces smooth, puberulous, most densely at the apex, with three fine white to pale yellow ribs, style base not enlarged, epidermal cells irregular, inconspicuous; embryo not examined. Photosynthetic pathway inferred from anatomy to be C_3 (*Whaite 4323A*; *Wilson 2853*; Bruhl & Wilson 2007). *2n* = unknown. (Figure 16).

Diagnostic characters: The usually spiralled, relatively broad culms are very distinctive in the genus. Spiralled culms are otherwise only found in *T.* sp. Porongurup (I. Abbott 18), which differs in having compact, sometimes subglobular inflorescences and much finer culms. Aside from the culms, it differs from *T. compressa* and *T. newbeyi* in the fewer, more distant spikelets.

Distribution: Endemic to the south-west of Western Australia, from just west of Esperance to Cape Arid, on near-coastal sand plains.

Habitat: Grows in low heath or open shrubland, usually on white sand plains, sometimes below granite outcrops, sometimes on white or yellow sand dunes, and sometimes in sandy gravel. Recorded in association with *Adenanthos cuneatus*, *A. dobsonii*, *Andersonia micrantha*, *A. parvifolia*, *Anarthria scabra*, *Aotus* sp. Esperance (P.G. Wilson 7904), *Banksia nutans*, *B. obovata, B. obtusa, B. petiolaris, B. pulchella, B. speciosa*, *Beaufortia elegans*, *Boronia crassifolia*, *Calectasia jubilaea*, *Calytrix decandra*, *Caustis dioica*, *Chaetospora curvifolia*, *C. subbarbata*, *Chordifex crispatus*, *C. sphacelatus*, *Chorizema obtusifolium*, *Conospermum distichum*, *Conothamnus aureus*, *Cyathochaeta clandestina*, *C. equitans*, *Daviesia major*, *Eucalyptus angulosa*, *E. angustissima*, *E. tumida*, *Gahnia trifida*, *Gompholobium scabrum*, *Jacksonia spinosa*, *Lepidosperma* spp., *Leptospermum spinescens*, *Logania serpyllifolia*, *Lyginia imberbis*, *Mesomelaena graciliceps*, *M. stygia*, *M. tetragona*, *Microcorys barbata*, *M. purpurea*, *Nuytsia floribunda*, *Phyllangium divergens*, *Pultenaea heterochila*, *Schoenus brachyphyllus*, *S. caespititius*, *S. cygneus*, *S. submicrostachyus*, *Stachystemon polyandrus*, *Stirlingia anethifolia*, *Stylidium breviscapum*, *S. repens*, *S. rupestre*, *Taxandria* sp., *Thelymitra granitora*, *Thomasia angustifolia* and *Trachymene pilosa*.

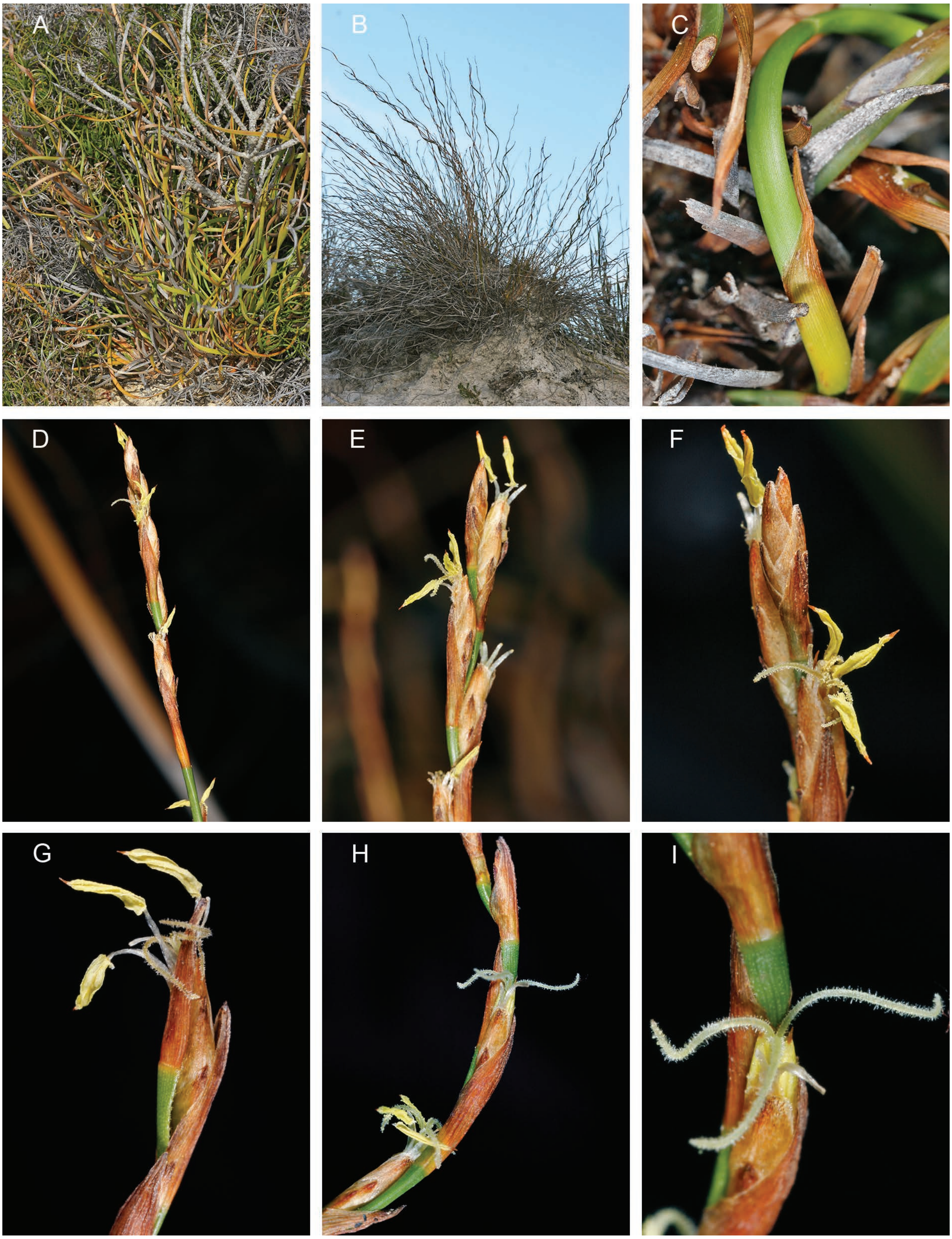

Fig. 16. *Tricostularia aphylla*. A. Habit at Lucky Bay, Western Australia. B. Habit at Cape Arid. C. Leaf sheath with reduced leaf lamina. D, E. Inflorescence. F, G. Spikelets with anthers and emerging stigmas. H, I. Spikelets with stigmas. Vouchers: A: *R.L. Barrett RLB 2753*; B: *R.L.Barrett & M.D. Barrett RLB 2905*; C–I: *R.L. Barrett RLB 4293* (all PERTH). Photos by R.L. Barrett.

Phenology: Flowers recorded for October–November. Fruit recorded for November.

Conservation status: Localised in distribution, but locally common and conserved within Cape Arid and Cape le Grand National Parks. IUCN: Least Concern.

Selected specimens examined: WESTERN AUSTRALIA: Lucky Bay Road, Cape Le Grand National Park, 14 July 2005, *R.L. Barrett RLB 2753* (PERTH); corner of Dempster Road and Scadden Road, 28 Oct. 2005, *R.L. Barrett & M.D. Barrett RLB 2905* (NSW, PERTH); cultivated material, originally collected from N side of Fisheries Road, E of Condingup Hill, E of Esperance, 18 Oct. 2007, *R.L. Barrett RLB 4293* (PERTH); *c.* 2 km S of entry to Cape Le Grand National Park, 21 Jan. 2008, *R.L. Barrett & M. Moody RLB 4307* (PERTH); Old Smokey Road, Esperance, 3 Oct. 1995, *R.J. Cranfield 10399* (NSW, PERTH); 3 km W of Israelite Bay ruins, 7 Jan. 1979, *M.D. Crisp 4884* (CBG, NSW); Esperance Bay, [1901], *L. Diels 5903* (K); Israelite Bay road, 10.7 miles E of Esperance-Norseman road, 5 Dec. 1960, *A.S. George 2003* (PERTH); 8.4 km N of Lucky Bay Road on Cape Le Grand Road, *c.* 10 km NNW of Lucky Bay, 31 Oct. 1997, *B.J. Lepschi & B.A. Fuhrer BJL 3830* (AD, CANB, MEL, NSW, PERTH); 12 km NNE of Mount Arid, Cape Arid National Park, *c.* 120 km E of Esperance, 5 Nov. 1980, *K.R. Newbey 7990* (PERTH); at Tagon Harbour, Cape Arid National Park, E of Esperance, 3 Dec. 1971, *R.D. Royce 10046* (CANB, PERTH); Esperance area, along Le Grand Road, 6 km N of border to Cape Le Grand National Park, 6 Nov. 1982, *A. Strid 21192* (K, NE, NSW, PERTH); Cape Le Grand (National Park), about 20 miles SE of Esperance, 6 Nov. 1971, *A.S. Weston 7073* (AD, CANB, PERTH); near Whartons Campsite near west end of Duke of Orleans Bay, 16 Oct. 1976, *T.M. Whaite & J. Whaite 4323A, 4323B* (K, NSW); *c.* 1 km W of Rossiter Bay on road to Lucky Bay, 14 Oct. 1979, *K.L. Wilson 2853* (NSW, PERTH); *c.* 1 km E of Whartons Campsite, Duke of Orleans Bay, 14 Oct. 1979, *K.L. Wilson 2874* (NSW, PERTH); 87 km E of Condingup on the track to Israelite Bay, Eyre District, 1 Dec. 1994, *K.L. Wilson & K. Frank KLW 9231* (NSW, PERTH); 0.5 km along Wharton Road from intersection with Orleans Bay Road, E of Esperance, 13 Oct. 2013, *K.L. Wilson 11008* (NSW); Cape Le Grand Road, 4.7 km S of Merrivale Road, 14 Oct. 2013, *K.L. Wilson 11018* (NSW); Lucky Bay, *c.* 35 km ESE of Esperance, 8 Oct. 1966, *P.G. Wilson 5599* (NSW, PERTH).

Etymology: From the Latin *aphylla* (leafless), presumably in reference to the leaves being reduced to sheaths with only a residual lamina.

Common names: Medusa Sedge; Spiral Tricostularia.

Notes: The specimen listed as holotype is from Brown's personal herbarium. The specimens listed as isotypes are known to have been separated prior to the description of the species being prepared, so they are duplicates, but were not used when preparing the description (D. Mabberley *pers. comm.*). This satisfies the criteria of Article 9.1 for recognition of a holotype (Turland *et al.* 2018).

Fertile material has rarely been collected as the spikelets are caducous once the fruit matures. In the absence of good material to determine relationships, this species was doubtfully included in *Lepidosperma* for 202 years (Barrett and Wilson 2012).

Tricostularia bennettiana R.L.Barrett & K.L.Wilson, *sp. nov*.

Type: Western Australia: 46 km E of Ravensthorpe on Esperance road, 13 Oct. 1979, *K.L. Wilson 2810* (holo: NSW 687621; iso: K, P, PERTH 2334585, READING).

Tricostularia sp. Hopetoun (M. Bennett 646), *FloraBase* (2008–), accessed 4 June 2020.

Illustration: Wheeler and Graham (2002; fig. p. 298, left-hand inflorescence only, as *T. neesii*).

Perennial tufted herb, 0.15–0.3 m high; plants clonal, forming dense tussocks 0.1–0.3 m across; rhizome thin, woody, short, branched, 1–1.5 mm diam., non-pseudobulbous; old leaf sheaths covering the rhizome, not breaking apart into fine fibres with age, pale brown; roots sand-binding. *Stems* slender, rigid, erect, with 1 node, terete, very finely striate, 0.6–1.1 mm diam., smooth, glabrous, green to yellow-green, base not enlarged. *Leaves* mostly basal, numerous, and 1 cauline; phyllotaxy loosely spirotristichous; sheath 16–28 mm long, 1.0–1.4 mm wide, slightly broader than the leaf lamina, margins very finely scabrid, otherwise glabrous, red-brown, dull, upper margin membranous, oblique, finely ciliate, ligule absent; cauline sheath tight around culm; *pseudopetiole* obscure or absent; basal leaves with a much reduced lamina, not exceeding the culms, lamina dorsiventral, 0.1–0.3 cm long, *c.* 0.05 mm wide; bases white-membranous, not dividing; lamina ± linear, ± flat, ± flexuous, old leaf tips not curling, finely multi-striate, margins very finely scabrid, otherwise glabrous when young, green, concolorous, weakly keeled along mid-nerve, margins ribbed and finely scabrous, not recurved, apex long-attenuate; lowest leaves reduced to a sheath, lacking a lamina, pale to reddish brown. *Inflorescence* contracted, panicle-like, narrow, shortly elongate, somewhat flexuous, with 2–4 nodes, 1.5–3.5 cm long, 5–8 mm wide, sometimes interrupted, axis green or yellow-green, not glaucous; bracts reduced leaf-like, with 3 distinct veins, exceeding the spikelet clusters, sheaths open, partly enveloping the higher bracts, gradually reducing along the inflorescence, basal bract much shorter than inflorescence, to 9 mm long; branches erect, with 1–3 spikelets in a terminal cluster (sometimes with a second distant cluster), spikelet(s) on short, terete, glabrous peduncles 0.5–1 mm long, arising in each bract axil; cladoprophyll subtending each spikelet bract-like, sheath 3.2–3.5 mm long, brown, with a distinct midrib, partially enclosing the spikelet, with a slender lamina

1.8–3.0 mm long, reddish brown. *Spikelets* reddish brown, lanceolate, 4–6 mm long, ± terete to somewhat compressed, with 5 or 6 glumes, only topmost 2 fertile, both bisexual, fertile, no reduced glume above the florets; glumes distichous, basal glume 2.2–2.7 mm long, fertile glumes 3.7–4.9(–5.6) mm long, 1.3–1.6 mm wide, membranous, pale red-brown to dark red-brown sparsely scabrous on the keel and margins, lamina glabrous, ovate-lanceolate, acuminate, with a mucro to 0.7 mm long, keel distinct; rachilla shortly elongate and not or scarcely sinuous in fruiting spikelets. *Perianth segments* 6, whitish, minute, 0.6–1.0 mm long, expanded below, filiform above, with a few stiff apical hairs. *Stamens* 3; anther connective 3.4–4.3 mm long, subulate; anthers cream, 2.6–3.0 mm long, with a glabrous apical appendage up to 0.5 mm long. *Style* trifid, base 3.1–4.3 mm long, glabrous and slender below, hairy and dilated in apical third, branches 2.1–2.8 mm long, hispidulous. *Nutlet* shortly stipitate, stipe *c.* 0.3 mm long, very constricted, obovoid to obpyriform, obscurely trigonous, dull, mid-brown to dark brown, 1.2–1.5 mm long including the stipe and style base, 0.8–0.9 mm diam., faces smooth, puberulous especially near apex, epidermal cells square–hexagonal, inconspicuous, with three fine white ribs, style base only slightly enlarged, thick, persistent, very shortly conical, *c.* 0.2 mm long; embryo not examined. Photosynthetic pathway inferred from anatomy to be C_3 (Takeda *et al.* 1985; *Orchard 1531*). *2n* = unknown. (Figure 17).

Fig. 17. *Tricostularia bennettiana*. A. Habit at Stokes Inlet, Western Australia. B. Plant base with sand-binding roots. C. Inflorescences (including old inflorescence axes on right hand side). Vouchers: A, B: *A.E. Orchard 1531* (NSW); C: *K.L. Wilson 2932* (NSW). Photos A–C by R.L. Barrett.

Diagnostic characters: Related to *T. neesii*, differing in the tightly tufting habit, thin, culms with one node, shortly elongate, robust, inflorescences and inflorescence bracts exceeding the paired spikelets.

Distribution: Endemic to the south-west of Western Australia, between Ongerup and Cape Arid.

Habitat: Grows in deep white, yellow or grey sands on plains, sometimes adjacent to salt pans, or on gentle slopes, growing in heath or open mallee scrub. Recorded in association with *Banksia gardneri*, *Caustis dioica*, *Cyathochaeta clandestina*, *Eucalyptus tetragona*, *E. tetraptera*, *Lepidosperma carphoides*, *L.* sp. Clathrate (R.L. Barrett & G.F. Craig RLB 3570), *L.* sp. Jerdacuttup (R.L. Barrett RLB 2770), *L.* sp. P2 Capitate (K.L. Wilson 2798), *L.* sp. Z dark sheath (P.G. Wilson 10177), *Mesomelaena stygia*, *Schoenus caespititius*, *S. cygneus*, *S. submicrostachyus* and *Tricostularia lepschii*.

Phenology: Flowers October–November.

Conservation status: Recorded as locally common and probably not threatened. Conserved within Fitzgerald River National Park. IUCN: Least Concern.

Specimens examined: WESTERN AUSTRALIA: Hopetoun airstrip, turnoff on road 5.8 km N of Hopetoun, 21 Oct. 2000, *M. Bennett 646* (PERTH); 0.2 km E of Rock Hole Road on Rawlinson Road, Reserve 31754, Oct. 1984, *M.A. Burgman 4572* (PERTH); 17 miles from Ravensthorpe, towards Lake King (315–316 mile posts), 6 Nov. 1968, *E.M. Canning 7256* (NSW, PERTH); NE of Jerramungup, 20 Nov. 1965, *A.S. George 7038* (PERTH); Boxwood Hill, at junction of South Coast Highway and Bremer Bay Road, 8 October 2003, *J. Hodgon 813 & J.J. Bruhl* (BOL, EIU, GENT, K, MO, NE, NSW, NY, PERTH, PRE); scrub N of Fisheries Road, *c.* 10 km ESE of Howick Hill, Eucla Division, Esperance district, 17 Sept. 1968, *E.N.S. Jackson 417* (PERTH); 30 km SE of Ongerup, 5 Nov. 1974, *K.R. Newbey 4915* (PERTH); near western border of Shire of Esperance, Location 1099, *c.* 45 km N of the coast at Stokes Inlet, Eucla Division, 14 Oct. 1968, *A.E. Orchard 1531* (AD, *n.v.*, CANB, NSW, PERTH); below Perkins Rock, Fitzgerald River Reserve [National Park], 22 Oct. 1970, *R.D. Royce 9216* (PERTH); 19 km S of Lake King on Ravensthorpe road, 13 Oct. 1979, *K.L. Wilson 2803* (NSW, P, PERTH); S of Lake King, 6 Nov. 1994, *K.L. Wilson 8780* (NE, NSW, PERTH); opposite Jerdacuttup wheat silo, 6.7 km S of South Coast Highway on Fence Road, 29 Nov. 1994, *K.L. Wilson 9163* (NE, NSW, PERTH).

Etymology: Named in honour of botanist Merle Bennett OAM (1929–), of Hopetoun, long-time coordinator of the Ravensthorpe Wildflower Show and Ravensthorpe Regional Herbarium. She has contributed many valuable plant specimens to the Western Australian Herbarium, including this species. She is a co-author of *Native plants of the Ravensthorpe region* (Craig *et al*. 2011).

Common name: Bennett's Tricostularia.

Notes: A relatively distinctive species that was previously confused with immature specimens of *T. compressa*.

Tricostularia compressa Nees ex Lehm., *Nov. Stirp. Pug*. 8: 51 (1844).

Chaetospora spicata Boeckeler, *Linnaea* 38(3): 297 (1874), *non Chaetospora compressa* Gray (1821). *Schoenus tricostularia* F.Muell., *Syst. Census Austral. Pl.* 1: 128 (1882).

Type citation: "Crescit in locis rupestribus collium "Konkoberup Hills" (Kent) (Herb. Preiss no. 1800.)"

Type: Western Australia: Konkoberup Hills, Kent [= Mount Melville, near Cape Riche], 21 Nov. 1840, *L. Preiss* [*Pl. Preissianae No. 1800*] (lectotype (here designated): LD 1732307; isolectotypes: G 00195293, MEL 2297587, MEL 2297588, P 01926657).

Illustration: Kaphahn (1905; figs 19, 20).

Perennial tufted herb, (0.15–)0.3–0.45 m high; plants clonal, forming dense to spreading tussocks 0.1–0.6 m across; rhizome thin, woody, short, branched, 0.7–1.2 mm diam., not pseudobulbous; old leaf sheaths covering the rhizome, not breaking apart into fine fibres with age, pale brown, prominently nerved; roots sand-binding. *Culms* slender, rigid, erect, not noded or occasionally with one node just below the inflorescence, compressed, semi-terete or terete, not or finely grooved, 0.4–0.6 mm diam., smooth, glabrous, dull green to yellow-green, base not enlarged. *Leaves* all basal, 2 or 3; phyllotaxy loosely spirotristichous; sheath 9–44 mm long, 0.8–0.9 mm wide, much broader than the leaf lamina, margins glabrous, reddish-brown at the base, straw-coloured or pale brown above, dull, upper margin narrowly membranous, oblique, glabrous, ligule absent; sheath tight around culm; *pseudopetiole* obscure or absent; leaves usually with a much reduced lamina to 1 mm long, to 0.3 mm wide, but young or regenerating plants sometimes have a lamina to 11 cm long; lamina highly reduced, ± triangular, glabrous, brown, concolorous, apex acute. *Inflorescence* contracted, panicle-like, narrow, erect, with 2–4 nodes, 1.5–3.2 cm long, 4–7 mm wide, usually somewhat interrupted, axis green or yellow-green, not glaucous, a few short, scabrid hairs on the margins; bracts reduced, not exceeding the spikelet clusters, light or orange-brown, shiny, sheaths open, not enveloping the higher bracts, gradually reducing along the inflorescence, basal bract much shorter than inflorescence, 7–11 mm long; branches erect, with 3–5 spikelets per cluster, arising in each bract axil, spikelet on short, compressed, glabrous peduncles *c*. 1 mm long; spikelet prophyll present, sheath 1.3–1.5 mm long, brown, with distinct midrib, partially enclosing the spikelet, acuminate, with a slender lamina 0.4–0.9 mm long, brown. *Spikelets* brown, ± oblate, 2.8–5.1 mm long, 0.9–1.6 mm wide, compressed, with 4 or 5 glumes, only topmost 2 fertile, the lower flower male, fertile, the upper flower bisexual, fertile, no reduced glume above the florets; glumes subdistichous, basal glume 1.4–2.3 mm long, fertile glumes 3.3–4.1 mm long, 0.8–1.1 mm wide, membranous, pale brown, orange-brown or red-brown (apex often darker than body), keel and lamina glabrous, ovate, obtuse to acute, mucro absent, keel distinct; rachilla compact and not or scarcely sinuous in fruiting spikelets. *Perianth segments* 6, whitish, minute, 0.3–0.9 mm long, subulate, tapering to a fine point. *Stamens* 3; anther connective 3.0–3.7 mm long, subulate; anthers pale yellow, 2.8–3.5 mm long, with a glabrous apical appendage up to 0.5 mm long. *Style* trifid, base 1.4–1.7 mm long, glabrous, slender, slightly tapering below, branches 1.3–1.9 mm long, hispidulous. *Nutlet* shortly stipitate, stipe *c*. 0.5 mm long, somewhat constricted, ± obovoid, obscurely trigonous, dull, mid-brown, 1.6–1.8 mm long including the stipe, 0.9–1.0 mm diam., faces smooth but shortly hispidulous, epidermal cells ovoid–hexagonal, inconspicuous, with three fine, hispidulous white ribs, style base not enlarged; embryo not examined. Photosynthetic pathway not examined. (Figure 18).

Diagnostic characters: Rhizome very compact. Culms compressed to terete, usually nodeless. Inflorescence short, compact (1.5–3.2 cm long). Inflorescence bracts short, lower bract 7–11 mm long, not exceeding lower branchlet.

Distribution: Endemic to the south-west of Western Australia, between Walpole, the Stirling Range and Cape Arid.

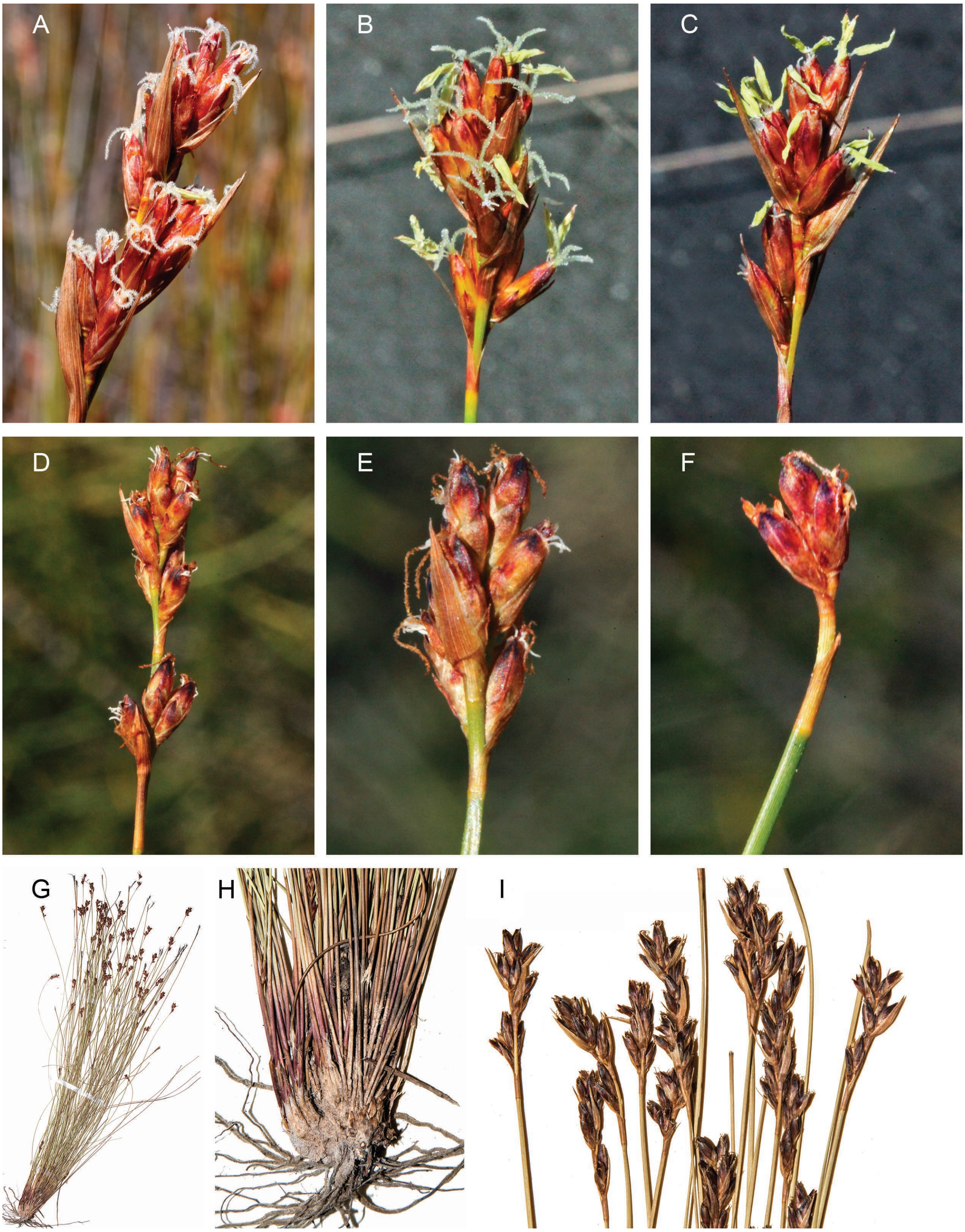

Fig. 18. *Tricostularia compressa*. A–C. Flowering inflorescences at Bayonet Head. D–F. Immature or depauperate inflorescences. G. Habit at Stirling Range, Western Australia. H. Plant base. I. Inflorescence. Vouchers: A–C: *G. Byrne 4483* (PERTH); D–F; *G. Byrne 4941* (PERTH); G, H: *A. Strid 21578* (NSW); I: *J.H. Maiden s.n.* (NSW 75058) Photos A–F by G. Byrne; G–I by R.L. Barrett.

Habitat: Grows in Proteaceae dominated shrublands and heath and mallee woodlands in deep to shallow white or grey sands or clay soils, commonly with gravel or laterite, sometimes over granite, in red-brown sandy loam or pale grey loamy sand, on flat or undulating sandplains, old sand dunes and gentle slopes. Recorded in association with *Acacia* sp., *Adenanthos apiculatus*, *A. drummondii*, *Allocasuarina humilis*, *Anarthria humilis*, *Austrostipa* sp., *Banksia coccinea*, *B. falcata*, *B. nutans*, *B. obovata*, *B. plumosa*, *B. prostrata*, *Boronia spathulata*, *B. speciosa*, *Caustis dioica*, *Chaetanthus tenellus*, *Chordifex capillaceus*, *Chorizandra enodis*, *Conospermum* *coerulescens*, *C. floribundum*, *Conostylis vaginata*, *Desmocladus fasciculatus*, *D. laxiflorus*, *Eucalyptus angulosa*, *E. marginata*, *E. pachyloma*, *E. pleurocarpa*, *Gahnia trifida*, *Gastrolobium retusum*, *Gompholobium villosum*, *Goodenia trinervis*, *Grevillea cagiana*, *G. nudiflora*, *Hakea ceratophylla*, *H. corymbosa*, *H. cucullata*, *H. denticulata*, *H. ferruginea*, *H. florida*, *H. laurina*, *H. marginata*, *H. nitida*, *H. pandanicarpa* subsp. *crassifolia*, *H. trifurcata*, *Lambertia inermis*, *Lepidosperma* spp., *Leucopogon tamariscinus*, *Machaerina juncea*, *Melaleuca suberosa*, *M. thymoides*, *M. violacea*, *Mesomelaena stygia*, *M. tetragona*, *Nuytsia floribunda Oligarrhena micrantha*, *Petrophile filifolia*, *Platytheca galioides*, *Pultenaea ericifolia*, *Regelia* sp., *Rhytidosperma* sp., *Rinzia schollerifolia*, *Schoenus brachyphyllus*, *S. globifer*, *S. subfascicularis*, *Spyridium majoranifolium Stirlingia latifolia*, *Taxandria spathulata*, *Tetratheca pubescens*, *Tricostularia exsul* and *T. neesii*.

Phenology: Flowers mainly October–December.

Conservation status: Relatively widespread and not considered threatened. Conserved in Cape Arid, Cape le Grand, Fitzgerald River and Stirling Range National Parks. IUCN: Least Concern.

Selected specimens examined: WESTERN AUSTRALIA: Bell Track N, Fitzgerald River National Park, 5 Oct. 1996, *S. Barrett 760* (PERTH); South Stirling, just W of township, 4 Oct. 1976, *B.G. Briggs 6585* (NSW); South Stirling, just W of township, 4 Oct. 1976, *B.G. Briggs 6587* (NSW); South Stirling, just W of township, 4 Oct. 1976, *B.G. Briggs 6600* (NSW, PERTH); South Stirling, just W of township, 4 Oct. 1976, *B.G. Briggs 6604* (NSW, PERTH); Reserve NW of Lower King Road, Bayonet Head, 12 Nov. 2012, *G. Byrne 4483* (NSW, PERTH); 4.3 km from the Cape Riche Camping Ground on Sandalwood Road, 27 Oct. 2013, *G. Byrne 4941* (PERTH); Cranbrook catchment, 2 km E of Cranbrook, 10 Dec. 1996, *R. Davis 1721* (PERTH); 50 m along Warramurrup Road from junction of Borden/Bremer Bay Road, c. 20 km W of Bremer Bay, 14 Nov. 2001, *R. Davis 10147* (AD, *n.v.*, PERTH); near Esperance, [1901], *L. Diels 5422* (PERTH); Eucla division, Esperance district, roadside *c.* 2 km S of Gibson, 20 Oct. 1968, *N.N. Donner 3081* (AD, NSW, PERTH); Swan River Colony, 1848, *J. Drummond 348* (MEL, P (2 sheets), PERTH); Whoogarup Range, SSW of Ravensthorpe, 2 Dec. 1960, *A.S. George 1917* (PERTH); first firebreak S of Hamilla Road, *c.* 1.2 km W of NE corner, 30 Jan. 2001, *M. Hislop 2537* (NSW, PERTH); SW of Boxwood Hill, 300 m W of South Coast Highway along Old Boundary Road, 8 Oct. 2003, *J. Hodgon 812 & J.J. Bruhl* (NE, NSW, PERTH); 7 km along Salt River Road from Formby South Road, to Cranbrook, Stirling Ranges, 14 Nov. 1982, *G.J. Keighery 5760* (NSW, PERTH); Mount Baring, Cape Arid National Park, 29 Oct. 1990, *G.J. Keighery 11791* (PERTH); on S side of Brockway Road, 4 km W of Esperance-Norseman Road. Helms Arboretum, *c.* 19 km NNW of Esperance. [Plot - ES02], 12 Oct. 2000, *G.J. Keighery & N. Gibson 5284* (CANB, NSW, PERTH); 7.1 km E of South Coast Highway on Swamp Road, *c.* 18 km N of Beaufort Inlet, 26 Oct. 1997, *B.J. Lepschi & B.A. Fuhrer BJL 3712* (AD, CANB, NSW, PERTH); 38.9 km N of Ravensthorpe on the road to Munglinup, 29 Oct. 1997, *B.J. Lepschi & B.A. Fuhrer BJL 3795* (CANB, NSW, PERTH); Kalgan Plains, Dec. 1909, *J. Maiden s.n.* (NSW 750058, PERTH 2334240); 15 km S of Needilup, 21 Oct. 1975, *K.R. Newbey 4880* (CBG, MEL, PERTH); 0.6 km N of Gibson, 26 km N of Esperance, 13 Nov. 1980, *K.R. Newbey 8170* (CBG, PERTH); *c.* 3 km N of Mount Frankland, N from Walpole on the road to Lake Muir, 11 Dec. 1974, *R. Pullen 9958* (CANB, NSW, PERTH); along Balladonia road S of Mount Ragged, Cape Arid National Park, E of Esperance, 4 Dec. 1971, *R.D. Royce 10074* (PERTH); Stirling Range National Park, southern plains W of Chester Pass Road, 11 Nov. 2004, *E.M. Sandiford EMS 988* (PERTH); At intersection of South Coast Highway and Bremer Bay Road, 22 Oct. 1982, *A. Strid 20914* (NSW); 22 km from Condingup along road to Esperance, 8 Nov. 1982, *A. Strid 21257* (NSW); Stirling Range Drive N of Toolbrunup Peak, Stirling Range National Park, 25 Nov. 1982, *A. Strid 21578* (NSW); Helms Arboretum, Brockway Road, roadside next to Eucalypt plantation, 28 Oct. 1998, *C.D. Turley 8/1098* (PERTH); 643 Boxwood Hill–Ongerup Road, Middle Track, 1.3 km W of paddock, Boxwood Hill, 19 Nov. 2007, *J.E. Wajon 1608* (PERTH); Stirling District, *c.* 20 km W of Ongerup, 11 Nov. 1974, *D.J.E. Whibley 5276* (AD, PERTH); *c.* 1 km E of Whartons Campsite, Duke of Orleans Bay, 14 Oct. 1979, *K.L. Wilson 2873* (NSW, PERTH, P); 16 km W of 'Gairdner River' on Ongerup road, 16 Oct. 1979, *K.L. Wilson 2908* (NSW, PERTH); *c.* 5 km NW of Cape Riche on Wellstead road, 16 Oct. 1979, *K.L. Wilson 2938* (NSW, PERTH, P); 1 km N of Starvation Boat Harbour on road to Springhole Road, 29 Nov. 1994, *K.L. Wilson 9174 & K. Frank* (NE, NSW, PERTH).

Etymology: From the Latin *compressus*, apparently in reference to the distinctly compressed culms (and in contrast to the terete culms of *T. neesii*).

Common name: Clustered Tricostularia.

Notes: This name has been very widely applied to a number of the taxa recognised as distinct species in this paper.

While there is only a single collection nominated as the type, sets were distributed by Nees, and the specific location of the type is not designated by Lehmann (1844). We have chosen the sheet at LD as lectotype as this was Nees' primary set and it has ample material on the sheet.

Young, resprouting or depauperate plants can have a distinctive appearance, with distinctly developed leaf laminas, somewhat flexuous to sinuous nodeless culms that are compressed and oval or sometimes angular, and small inflorescences with few spikelets. *Pullen 9958* (CANB, NSW, PERTH) has culms with 2 nodes and may be closer to *T. newbeyi*.

Tricostularia davisii R.L.Barrett & K.L.Wilson, *sp. nov*.

Type: Western Australia: 6 km SSW of Wellstead, 2 Nov. 1995, *R. Davis 302* (holo: PERTH 04423186).

Tricostularia sp. Wellstead (R. Davis 302), *FloraBase* (2008–), accessed 4 June 2020.

Perennial tufted herb, 0.1–0.6 m high; plants clonal, forming dense tussocks 0.15–0.7 m across; rhizome thin, woody, short, branched, 0.8–1.2 mm diam., non-pseudobulbous; old leaf sheaths covering the rhizome, not breaking apart into fine fibres with age, pale brown; roots sand-binding. *Culms* slender, rigid, erect, with 2 nodes, ± terete but very finely and irregularly ridged when dry, 0.35–0.8 mm diam., smooth, glabrous, green to yellow-green. *Leaves* mostly basal, few, and 2 cauline; phyllotaxy loosely spirotristichous; sheath 13–25 mm long, 0.5–0.8 mm wide, broader than the leaf lamina, margins very finely scabrid, otherwise glabrous, straw-coloured to brown, dull, upper margin narrowly membranous, oblique, finely ciliate, ligule absent; cauline sheath tight around culm for most of length, but open at the orifice; *pseudopetiole* obscure or absent; basal leaves with a much reduced lamina, not exceeding the culms, lamina dorsiventral, 0.3–1.0 cm long, 0.1–0.3 mm wide; bases not membranous, not dividing; lamina ± linear, ± flat, flexuous, finely multi-striate, margins and keel finely scabrid, otherwise glabrous, brown, concolorous, weakly keeled along mid-nerve, margins not recurved, apex long-attenuate, setaceous; lowest leaves reduced to a sheath, lacking a lamina, pale brown. *Inflorescence* subcapitate, much-contracted, panicle-like, obconic to obovate, with 3–5 nodes (but very compact and all nodes obscured by bracts), 0.7–1.5 cm long, 3–5 mm wide, not interrupted, axis green or yellow-green, not glaucous; bracts not leaf-like, long-attenuate (sometimes almost pungent), shortly to greatly exceeding the spikelet clusters, sheaths open, overlapping but not enveloping the higher bracts, gradually reducing along the inflorescence, basal bract exceeding inflorescence, to 15 mm long; branches erect, 0.5–1.1 cm long, with 1 or 2 spikelets in a terminal cluster, spikelet(s) on short, terete, glabrous peduncles 0.2–0.8 mm long, arising in each bract axil; spikelet prophyll present, sheath 0.6–0.9 mm long, brown, not enclosing the spikelet, acuminate, lamina ± absent. *Spikelets* brown, lanceolate, 3.7–5.1 mm long, 0.9–0.1.1 mm wide, semi-terete to compressed, with 6 glumes, only topmost 2 fertile, the lower flower male, the upper flower bisexual, fertile, no reduced glume above the florets; glumes distichous, basal glume 2.9–4.2 mm long, fertile glumes 3.2–4.2 mm long, 0.7–0.9 mm wide, membranous, very pale red-brown (apex often darker than body), ciliate on the keel and margins, lamina glabrous, lanceolate to obovate, acuminate, with a mucro 0.2–0.6 mm long, keel distinct; rachilla compact and not or scarcely sinuous in fruiting spikelets. *Perianth segments* 6, whitish, minute, 0.4–0.6 mm long, expanded only at base, tapering to a fine point, glabrous or apex minutely hispid. *Stamens* 3; anther connective 3.3–4.6 mm long, subulate; anthers cream, 2.4–2.6 mm long, with a glabrous apical appendage 0.6–0.8 mm long. *Style* trifid, base 1.2–2.0 mm long, glabrous, slender above, not dilated below, branches 1.4–1.9 mm long, hispidulous. *Nutlet* shortly stipitate, stipe *c*. 0.5 mm long, somewhat constricted, obovoid to obpyriform or broad ellipsoid, obscurely trigonous, shiny, dark brown to almost black, 1.2–1.7 mm long including the stipe and style base, 0.8–1.0 mm diam., faces smooth, sparsely puberulous, epidermal cells square–hexagonal, inconspicuous, with three fine white ribs, style base not enlarged, cap-like; embryo not examined. Photosynthetic pathway not examined. (Figure 19).

Diagnostic characters: Related to *T. neesii*, differing in the tightly tufting habit, thin, one or two nodes culms and small, subcapitate inflorescences with inflorescence bracts exceeding the spikelets. The erect cilia on the glume margins are also distinctive, the hairs on *T. neesii* are shorter and not erect.

Distribution: Endemic to the south-west of Western Australia, between Manypeaks and Cape Riche, east to Ravensthorpe and north to Lake King; possibly also near Witchcliffe and Beenup.

Habitat: Grows in mallee woodland and heath on flats, hillsides and valleys in a variety of soils including grey sand, brown sandy clay, swampy, peaty sand over clay, lateritic loam, granite, spongelite and soapstone, often in damp or winter-wet sites. Recorded in association with *Acacia aemula*, subsp. *muricata*, *A. luteola*, *Adenanthos cuneatus*, *Astartea aspera*, *A. pulchella*, *Calectasia gracilis*, *Chordifex capillaceus*, *Daviesia latifolia*, *Drosera roseana*, *Eucalyptus angulosa*, *E. lehmannii*, *E. neutra*, *E. preissiana*, *E. redunca*, *Franklandia fucifolia*, *Gahnia aristata*, *G. trifida*, *Gastrolobium bracteolosum*, *G. congestum*, *Goodenia incana*, *Lepidosperma carphoides*, *L. striatum*, *Leucopogon penicillatus*, *Machaerina juncea*, *Melaleuca spathulata*, *Mesomelaena graciliceps*, *M. stygia*, *Myoporum tetrandrum*, *Petrophile teretifolia*, *Pimelea angustifolia*, *Schoenus laevigatus*, *S. pleiostemoneus*, *S. subfascicularis*, *Stylidium albomontis*, *S. caricifolium*, *S. repens*, *Tricostularia compressa*, *T. newbeyi* and *Xanthosia huegelii*.

Phenology: Flowers recorded for October–November. Fruit recorded for November.

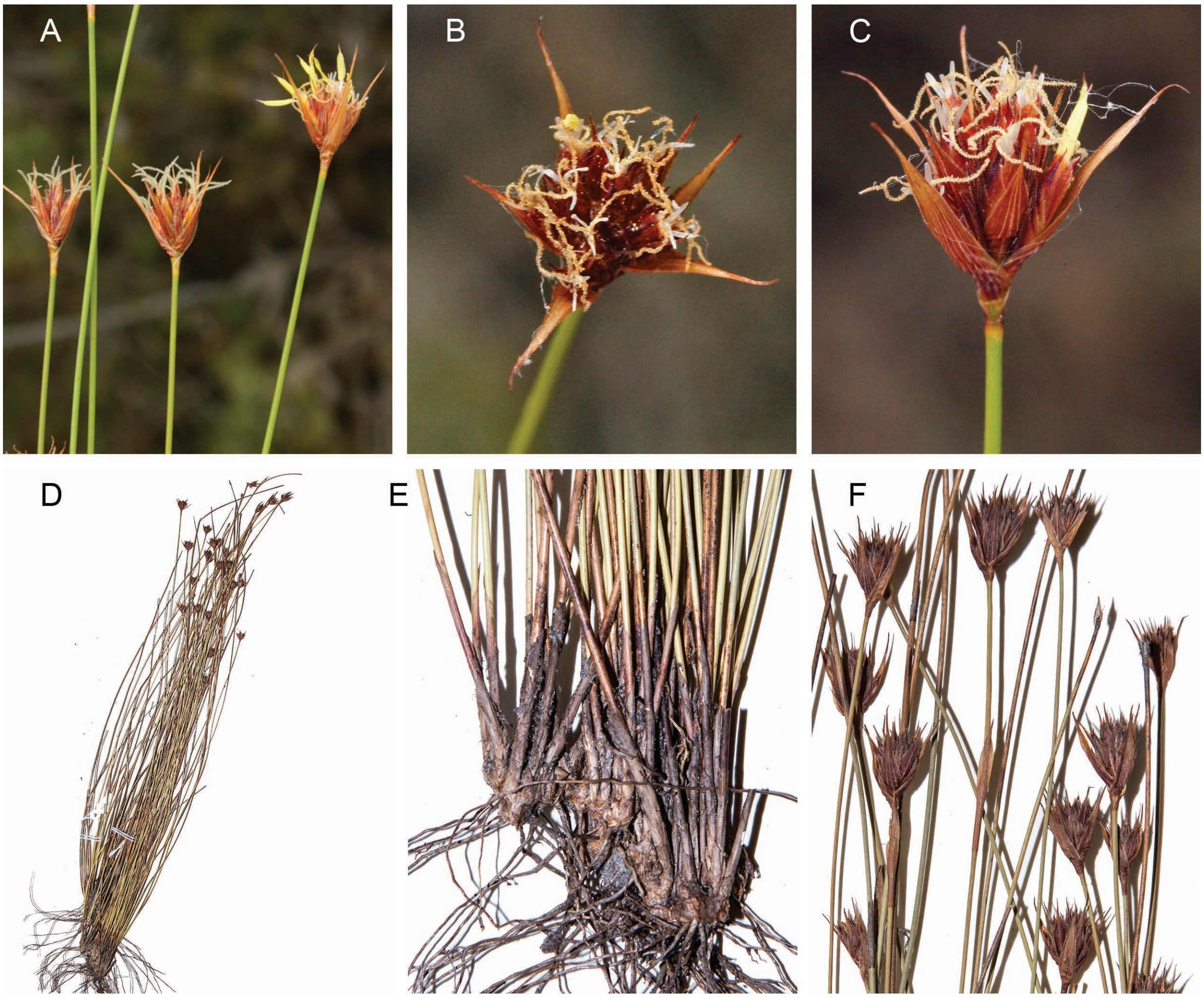

Fig. 19. *Tricostularia davisii*. Near Cape Riche, Western Australia. A–C: Flowering inflorescence. D. Habit. E. Plant base. F. Inflorescence. Vouchers: A–C: *G. Byrne 4937* (PERTH); D, E: *K. Newbey 4616*; F: *K.L. Wilson 2937* (NSW). Photos A–C by G. Byrne; D–F by R.L. Barrett.

Conservation status: Known from just eleven populations, two of which are roadsides, but conserved in Stirling Range National Park, Mount Manypeaks Nature Reserve, and two additional gazetted Nature Reserves. Further targeted surveys are warranted, but the species is probably not currently threatened. IUCN: Data Deficient.

Specimens examined: WESTERN AUSTRALIA: 4.3 km from the Cape Riche Camping Ground on Sandalwood Road, 27 Oct. 2013, *G. Byrne 4937* (PERTH); *c.* 22 km NE of Manypeaks, on Drawbin Road, *c.* 6 km from Pfeiffer Road, 4 Oct. 1976, *B.G. Briggs 6596* (NSW, PERTH); 90 km NE of Albany, 8 Nov. 1978, *R.J. Cranfield 1118* (MEL, NSW, PERTH); Seed orchard in gravel pit, 10 km from Hassell Highway, on Cheyne Beach Road, E of Albany, 8 Oct. 1997, *E.J. Croxford* 7962 (PERTH); Intersection McGregor Road and Governor Broome Road, Scott River Sandplain, 25 Nov. 1976, *G.J. Keighery 960* (PERTH); Forest Grove Road, 8 km SW [of] Witchcliffe, 18 Nov. 1980, *G.J. Keighery 3599* (PERTH); Western slopes Mount Manypeaks, 27 Nov. 1986, *G.J. Keighery 8829* (NSW, PERTH); Gazetted Reserve 13240, Cheyne Bay, N of Cape Riche, 24 Oct. 1996, *J.W. Mercer 87* (PERTH); 22 km NW of Cape Riche, 27 Nov. 1974, *K.R. Newbey 4616* (NSW, PERTH); Roadside along Toolbrunup Road, *c.* 1.3 km W from the intersection with Chester Pass Road, Stirling Range National Park, 15 Oct. 2007, *A.J. Perkins s.n.* (NSW 872772, PERTH, SYD); Gazetted Reserve 26688 on South Stirling Road, 3.3 km N of junction with Pfeiffer Road, 20 Oct. 1999, *E.M. Sandiford EMS 460* (PERTH); *c.* 5 km NW of Cape Riche on Wellstead road, 16 Oct. 1979, *K.L. Wilson 2937* (NSW, PERTH).

Etymology: In recognition of the work of Robert (Rob) W. Davis (1959–), botanist at the Western Australian Herbarium, in documenting the flora of Western Australia, especially the genus *Ptilotus* (Amaranthaceae; e.g. Hammer *et al.* 2019).

Common name: Davis' Tricostularia.

Notes: A very distinctive species with superficial resemblance to *Chaetospora* R.Br. due to the subcapitate heads and floral bracts that exceed the spikelets. Previously confused with *T. compressa* as it was often assumed these were immature plants of that species. Two disjunct collections, from near Beenup and Witchcliffe, are immature and are only tentatively included in this taxon.

Tricostularia drummondii (Steud.) R.L.Barrett & K.L.Wilson, *comb. nov*.

Basionym: *Discopodium drummondii* Steud., *Syn. Pl. Glum*. 2(8–9): 150 (1855).

Type citation: "Hrbr. Drummond coll. III. 328 et 329. N. Holl."

Type: Western Australia: [Swan River Colony, 1845], *J. Drummond* (3rd collection) *329* (lectotype (here designated): P 00603255; isolecto: G 00195298, G 00195299, G 00195300 (2 sheets), K 000960118, P, PERTH 2334488).

Excluded syntype (= *T. newbeyi*): Western Australia: [Swan River Colony, between Albany, Stirling Range, and Cape Riche, *c*. Aug. 1844], *J. Drummond 328* (3rd collection) (syn: BM, G 00195294 (2 sheets), G 00195295, G 00195296 (2 sheets), K 000960119, K 000960120, MEL 2204195, P 00603254, P 01926655, PERTH 2334828, TCD, *n.v*.).

Illustration: Wheeler and Graham (2002; fig. p. 298, right-hand inflorescence only, as *T. neesii*).

Insufficient material was available at NSW to complete a description.

Diagnostic characters: Related to *T. exsul*, differing in the shorter inflorescence (3–4 cm long) with fewer, finer spikelets. (Figure 20).

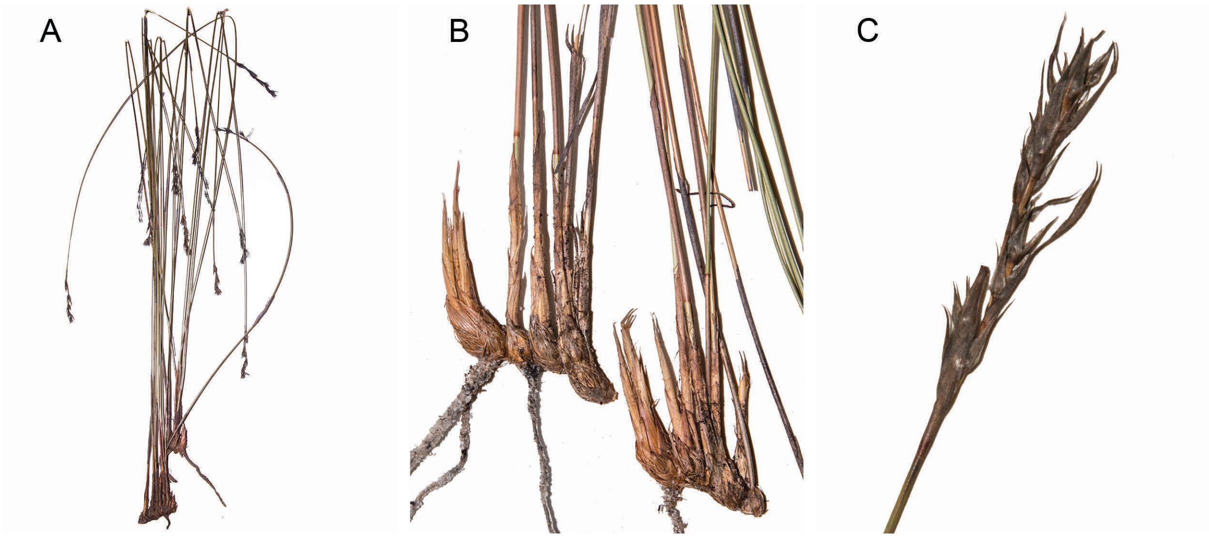

Fig. 20. *Tricostularia drummondii*. Near Beverley, Western Australia. A. Habit. B. Plant base. C. Inflorescence. Voucher: *N. Gibson 4035* (NSW). Photos by R.L. Barrett.

Distribution: Endemic to the south-west of Western Australia, between Perth and Arthur River.

Habitat: Grows in low woodland or mallee over sand or laterite, on flats, rises or sometimes in swampy areas. Recorded in association with *Banksia attenuata*, *B. menziesii*, *Conostylis serrulata*, *Cyathochaeta stipoides*, *Eremaea pauciflora*, *Eucalyptus marginata*, *E. wandoo*, *Evandra aristata*, *Ficinia nodosa*, *Gymnoschoenus anceps*, *Hibbertia subvaginata*, *Jacksonia hakeoides*, *Lambertia inermis*, *Phlebocarya ciliata*, Restionaceae, *Schoenus asperocarpus*, *S.* aff. *pedicellatus* and *S. sublateralis*.

Phenology: Flowers probably in spring.

Conservation status: Poorly known and further assessments are required. IUCN: Data Deficient.

Specimens examined: WESTERN AUSTRALIA: 2 miles NNE of Yeal Swamp in Wanneroo Forestry Reserve, 24 Feb. 1965, *Y. Chadwick 2565* (PERTH); on the western boundary of the reserve, 1.4 km N of Kempton Road, Wandoo Conservation Park, *c*. 27 km WSW of Beverley [Plot - YO14], 11 Sept. 1997, *N. Gibson 4035* (NSW, PERTH); Gazetted Reserve 9098; *c*. 16–19 km W of Wagin towards Arthur River, 26 Nov. 1984, *G.J. Keighery 7418* (PERTH); Talbot Road Reserve, Middle Swan, Midland, 6 Nov. 1990, *G.J. Keighery 11836* (PERTH); N of Matthew Road, *c*. 1.4 km W of Cunderdin-Wyalkatchem Road, *c*. 25 km N of Cunderdin, 20 Oct. 1997, *B.J. Lepschi, T.R. Lally & W.H. Treasure BJL 3577* (PERTH); Dryandra State Forest, 30 Dec. 1987, *D.M. Rose 602* (PERTH).

Etymology: Named for botanist James Drummond (1786–1863), a prolific collector of plants from the fledgling Swan River Colony from 1836 to 1852 (Erickson 1969; Barker 2005).

Common name: Drummond's Tricostularia.

Notes: While the generic name *Discopodium* Steud. is illegitimate, being a later homonym, the species name is validly published (Art. 55.1; Turland *et al*. 2018). The two cited specimens are here considered to belong to two distinct species. A lectotype is designated to fix the application of the name. P 00603255 is chosen as it is from Steudel's herbarium. Bentham (1878) considered the two syntypes to be referrable to *T. compressa* and *T. neesii*, but both specimens are here considered distinct from each of these species, and a new combination is made for *Discopodium drummondii* with one syntype as the lectotype, while the residual syntype is here assigned to a new species, *T. newbeyi*.

Tricostularia exsul (C.B.Clarke) K.L.Wilson & R.L.Barrett, *Austral. Syst. Bot.* 25: 286 (2012).

Lepidosperma exsul C.B.Clarke, *Kew Bull. Misc. Inf. Add. Ser.* 8: 47 (1908).

Type citation: 'AUSTRALIA. Swan River, Drummond, n. 330 (hb. DC.).'

Type: WESTERN AUSTRALIA. Swan River [colony], 1845, *J. Drummond 330* (lectotype (here designated): G-DC 00195302; isolecto: B 10 0277894 (fragment), G-DC 00195301, G-DC 00195303, K 000960117, K (ex TCD); P; TCD, *n.v.*).

Tricostularia neesii var. *elatior* Benth., *Fl. Austral.* 7: 384 (1878).

Type citation: 'Drummond, n. 322.'

Type: Western Australia: Swan River [colony], 1845, *J. Drummond 322* (holo: K 000960116!).

Perennial tufted herb, 0.4–1(–1.3) m high; plants clonal, forming dense tussocks 0.2–1.2 m across; rhizome thin, woody, short, branched, 1.6–2.3 mm diam., non- or slightly pseudobulbous; old leaf sheaths covering the rhizome, breaking apart into fine fibres with age, pale brown; roots sand-binding. *Culms* slender, rigid, erect, with 2 nodes, terete, finely striate, 35–90(–120) cm tall, 1.1–2.0 mm diam., smooth, glabrous, dull to bright medium green to yellow-green, base not enlarged, but noticeably thicker than apex. *Leaves* mostly basal, numerous, and 2 cauline; phyllotaxy loosely spirotristichous; sheath 33–80 mm long, 1.5–2.3 mm wide, broader than the leaf lamina, margins finely scabrid, otherwise glabrous, straw-coloured to reddish brown, dull, upper margin membranous, oblique, finely scabrid, ligule absent; cauline sheath tight around culm; *pseudopetiole* obscure or absent; basal leaves with a much reduced lamina, not exceeding the culms, lamina dorsiventral, 0.1–0.2 cm long, 0.4–0.6 mm wide; bases brown-membranous, not dividing; lamina ± linear or narrowly triangular, ± flat, ± flexuous, old leaf tips not curling, finely multi-striate, margins very finely scabrid (only visible at (40×), otherwise glabrous, brown, concolorous, weakly keeled along mid-nerve, margins not recurved, apex acute; lowest leaves reduced to a sheath, lacking a lamina, pale to reddish brown. *Inflorescence* elongate, panicle-like, narrow, somewhat flexuous, with 5–9 nodes, 8–12 cm long, 4–9 mm wide, sometimes interrupted at the base, axis green or yellow-green, not glaucous; bracts reduced leaf-like, ± equal the spikelet clusters, sheaths open, partly enveloping the higher bracts, gradually reducing along the inflorescence, basal bract much shorter than inflorescence, 20–30 mm long; branches erect, with usually 3 but up to 7 spikelets, spikelet(s) on short, compressed, scabrous peduncles 1–3 mm long, arising in each bract axil; basal branchlet 20–29 mm long; spikelet prophyll present, sheath 6.2–8.4 mm long, brown, with 3 distinct veins and many fine striations, partially enclosing the spikelet, with a slender lamina 3.3–4.6 mm long, brown. *Spikelets* brown, lanceolate, 8.5–11 mm long, 2.1–3.3 mm wide, subterete, with 5 or 6 glumes, only topmost 3 fertile, the lower flower male, sterile, the second flower male, fertile, the upper flower bisexual, fertile, sometimes with a highly reduced glume above the florets; glumes distichous, basal glume 3.6–4.2 mm long, fertile glumes 7.0–8.8 mm long, 1.3–2.2 mm wide, membranous, pale reddish brown, sometimes translucent, sparsely scabrous on the keel and margins, lamina glabrous, lanceolate, acuminate, with a mucro 0.3–1.0 mm long, keel distinct; rachilla compact and not sinuous in fruiting spikelets. *Perianth segments* 6, whitish, minute, 0.7–2.0 mm long, ± filiform, expanded below, tapering to a fine point, sparsely scabrous. *Stamens* 3; anther connective 5.9–7.8 mm long, subulate; anthers yellow, 3.6–4.1 mm long, with a glabrous apical appendage 0.8–1.2 mm long. *Style* trifid, base 3.6–4.1 mm long, glabrous, slender above and below (dilated on nutlet apex), branches 2.8–3.2 mm long, hispidulous. *Nutlet* shortly stipitate, stipe 0.5–0.6 mm long, somewhat constricted, broad ellipsoid, obscurely trigonous, dull, mid-brown to dark brown, 2.5–2.8 mm long including the stipe and style base, 1.3–1.5 mm diam., faces smooth, puberulous, densely so near apex, epidermal cells square–hexagonal, inconspicuous, with three fine white ribs, style base distinctly enlarged, thick, persistent, shortly conical; embryo not examined. Photosynthetic pathway not examined. (Figure 21).

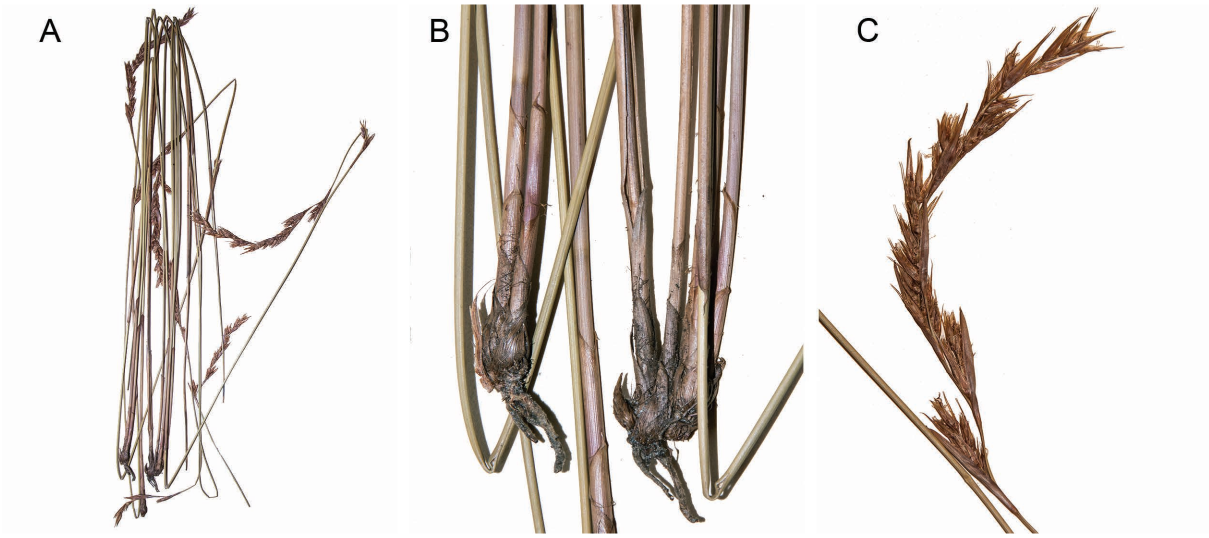

Fig. 21. *Tricostularia exsul*. Albany, Western Australia. A. Habit. B. Plant base. C. Inflorescence. Voucher: *C.R.P. Andrews s.n.* (NSW 687651). Photos by R.L. Barrett.

Diagnostic characters: Similar to *T. drummondii*, *T.* sp. Albany and *T.* sp. Two Peoples Bay, differing in the more robust rhizomes (1.6–2.3 mm diam.) and culms (1.1–2.0 mm diam.), and the larger inflorescences (8–12 cm long).

Distribution: Endemic to the south-west of Western Australia, between Albany and Manypeaks.

Habitat: Grows in swampy areas in heath on deep white or grey sands or clay loams. Recorded in association with *Acacia robiniae*, *Actinodium cunninghamii*, *Anarthria scabra*, *Aotus intermedia*, *Boronia crenulata*, *Callistemon glaucus*, *Cyathochaeta avenacea*, *Darwinia vestita*, *Daviesia incrassata*, *Eucalyptus marginata*, *E. staeri*, *Evandra pauciflora*, *Gompholobium scabrum*, *G. venustum*, *Hibbertia pulchra*, *Homalosermum firmum*, *Hovea chorizemifolia*, *Isopogon formosus*, *Latrobea diosmifolia*, *L. genistioides*, *L.* sp. South Coast (A.M.Ashby 1949), *Lepidosperma drummondii*, *L.* cf. *pubisquameum*, *L. striatum*, *L. ustulatum*, *L.* sp. Dunns Swamp (R.Davis 724), *Leucopogon glabellus*, *Lomandra nigricans*, *Melaleuca thymoides*, *Mesomelaena stygia*, *M. tetragona*, *Microtis atrata*, *Morelotia octandra*, *Pultenaea reticulata*, *Quinetia urvillei*, Restionaceae, *Schoenus armeria*, *S. globifer, S. obtusifolius*, *S. racemosus*, *Sphaerolobium hygrophyllum*, *S. pubescens*, *Stylidium assimile*, *S. luteum*, *Synaphea polymorpha* and *Tetratheca setigera*.

Phenology: Flowers recorded for November–December.

Conservation status: Poorly known and further surveys are recommended. Known to occur in Bakers Junction Nature Reserve where it is locally common. IUCN: Data Deficient.

Selected specimens examined: WESTERN AUSTRALIA: Albany, Dec. 1902, *C.R.P. Andrews s.n.* (NSW 687651); Bakers Junction Nature Reserve, N of Albany, 20 May 2008, *R.L. Barrett, E.M. Sandiford & D. Rathbone RLB 5020* (PERTH); South Coast Highway, 0.9 km SW of Homestead Road turn-off, 3 km SW of Manypeaks village, 22 Nov. 1994, *K.L. Wilson 9095 & K. Frank* (NSW).

Etymology: From the Latin *exsul* (exile), in reference to the fact that George Bentham had inadvertently sent the specimen originally at K to G (according to Clarke's annotation on the sheet in K) apparently thinking it represented a common species, leaving no material of the species at K, thus it was exiled to Geneva (Clarke 1908).

Common name: Robust Tricostularia.

Notes: A lectotype is selected for *Lepidosperma exsul* C.B.Clarke as, while Clarke (1908) specified material at G-DC, there are three sheets held at G-DC, and additional material at K (one sheet ex G-DC, ironically originally ex K), P and TCD. There may well be additional sheets that we are yet to trace as Drummond commonly collected many duplicates (see Barrett and Wilson 2012). We choose G-DC 00195302 as the lectotype as this sheet has the amplest material and an annotation by Clarke.

Wilson (1980) recognised that *Tricostularia neesii* var. *elatior* Benth. was the same as *T. exsul*, but species limits within *Tricostularia* were too poorly understood at that time to reinstate *T. exsul* (at that time known as *Lepidosperma exsul*).

Tricostularia lepschii R.L.Barrett & K.L.Wilson, *sp. nov*.

Type: Western Australia: *c*. 17.5 km W of Lake King township on road to Newdegate, 19 Oct. 1995, *B.J. Lepschi 2199* (holo: PERTH 4121643; iso: CANB 540114, NSW 687398).

Tricostularia sp. Lake King (A.M. Coates 2298), *FloraBase* (2008–), accessed 4 June 2020.

Perennial tufted herb, 0.15–0.4 m high; plants clonal, forming spreading tussocks *c*. 0.1–0.2 m across, culms in tight clumps, distinctly spaced at *c*. 1 cm intervals; rhizome thin, woody, short, branched, 1–2.6 mm diam., non-pseudobulbous; old leaf sheaths covering the rhizome, sometimes breaking apart into fine fibres with age, pale brown; roots sand-binding. *Culms* slender, rigid, erect, not noded, terete, very finely striate, 0.6–0.8 mm diam., smooth, glabrous, bright light green to yellow-green, base not enlarged. *Leaves* all basal, few; phyllotaxy loosely spirotristichous; sheath 14–59 mm long, 0.8–1.0 mm wide, slightly broader than the leaf lamina, margins glabrous, straw-coloured to pale brown, dull, upper margin membranous, oblique, glabrous or very finely ciliate, ligule absent; cauline sheath tight around culm; *pseudopetiole* obscure to distinct, semi-terete, up to 2.5 mm long; basal leaves with a much reduced lamina, not exceeding the culms, lamina dorsiventral, 0.25–0.35 cm long, 0.25–0.35 mm wide; bases white-membranous below pseudopetiole, not dividing; lamina ± linear, ± flat to slightly channelled, ± flexuous, old leaf tips not curling, finely multi-striate, margins finely scabrid, otherwise glabrous when young, green, concolorous, not keeled along mid-nerve, nerves obscure, margins not ribbed, finely scabrous, not recurved, apex long-attenuate, ± acute; lowest leaves reduced to a sheath, lacking a lamina, pale brown. *Inflorescence* very contracted panicle-like, subcapitate, with 1 or 2(?3) nodes, but very compact so nodes obscured by spikelets, 0.7–1.1 cm long, 4–8 mm wide, not interrupted, axis green or yellow-green, not glaucous; bracts reduced leaf-like, shorter than or equal to the spikelet clusters, sheaths open, not or somewhat enveloping the higher bracts, gradually reducing along the inflorescence, basal bract ± equal to inflorescence, 6–8 mm long; branches erect, with 2–4 spikelets in a terminal cluster, spikelets sub-fasciculate, on short, terete, glabrous peduncles 0.5–1 mm long, arising in each bract axil; cladoprophyll subtending each spikelet bract-like, sheath 3.1–3.6 mm long, brown, with a distinct midrib, partially enclosing the spikelet, with a slender lamina 0.9–1.2 mm long, brown. *Spikelets* brown, lanceolate, 4–6 mm long, compressed, with 6 glumes, only topmost 2 fertile, both bisexual, fertile, or the lower flower male, fertile, no reduced glume above the florets; glumes ± distichous, basal glume 1.5–3.0 mm long, fertile glumes 4.0–4.5 mm long, 1.0–1.1 mm wide, membranous, red-brown to dark red-brown, sparsely and finely scabrous on the keel, lamina glabrous, ovate-lanceolate, acute to acuminate, with a mucro to 0.6 mm long, keel distinct; rachilla compact and not or scarcely sinuous in fruiting spikelets, but the two fertile flowers presented beside each-other, so rachilla appearing flared at the apex. *Perianth segments* 6, whitish, minute, 0.4–1.1 mm long, compressed to ± filiform, expanded below, tapering to a fine point with a few apical hairs. *Stamens* 3; anther connective [not seen mature]; anthers 1.5–2.2 mm long, with a glabrous apical appendage up to 0.3 mm long. *Style* [not seen]. *Nutlet* shortly stipitate, stipe *c*. 0.3 mm long, scarcely constricted, broad ellipsoid, obscurely trigonous, dull, mid-brown, *c*. 2.0 mm long including the stipe and style base, *c*. 1.3 mm diam., faces smooth, finely puberulous, epidermal cells square–hexagonal, inconspicuous, with three fine white ribs, style base not enlarged; embryo not examined. Photosynthetic pathway not examined. *2n* = unknown. (Figure 22).

Diagnostic characters: Related to *T. neesii*, differing in the elongate rhizomes with tight clusters of culms at *c*. 1 cm intervals, thin culms without nodes, sub-capitate inflorescences and short inflorescence bracts. The two fertile flowers presented beside each other, so the rachilla appears flared at the apex, is unusual in the genus.

Distribution: Endemic to the south-west of Western Australia, between Kulin, Lake King and south towards Ravensthorpe.

Habitat: Grows in well-drained, deep, white, grey, or brown sands on flats or consolidated dunes, sometimes with laterite gravel or over clay in mixed open low scrub. Recorded in association with *Banksia* spp., *Callistemon phoeniceus*, *Conostylis* sp., *Eremaea* sp., *Eucalyptus tetragona*, *Grevillea* sp., *Hakea* spp., *Lepidosperma carphoides*, *L.* sp. Clathrate (R.L.Barrett & G.F.Craig RLB 3570), *L.* sp. Jerdacuttup (R.L.Barrett RLB 2770), *L.* sp. P2 Capitate (K.L.Wilson 2798), *Leptospermum spinescens*, *Melaleuca* spp., *Mesomelaena stygia*, *Schoenus caespititius*, *S. cygneus*, *S.* sp., *Tricostularia bennettiana* and *Verticordia* sp.

Phenology: Flowers probably August–October.

Conservation status: Recorded as locally common, particularly in disturbed areas, but only known from about six populations in the vicinity of Lake King (between Kulin and Ravensthorpe). Conservation Codes for Western Australian Flora: Priority 2 (as *Tricostularia* sp. Lake King (A.M. Coates 2298)). IUCN: Data Deficient.

Fig. 22. *Tricostularia lepschii*. Near Lake King, Western Australia. A. Habit. B. Plant base. C. Inflorescence. Voucher: *B.J. Lepschi 2199* (NSW). Photos by R.L. Barrett.

Specimens examined: WESTERN AUSTRALIA: [precise localities withheld for conservation reasons]: near Kulin, Aug. 1998, *E. Bennett & K. Del Fante DS 19.15* (PERTH); near Lake Grace, June 1991, *A.M. Coates 2298* (PERTH); near Ravensthorpe, Nov. 2016, *D. Coultas DC-01* (PERTH); near Ravensthorpe, Sept. 2014, *D. Coultas SC-05-02* (PERTH); near Kulin, Aug. 2000, *G.J. Keighery & N. Gibson 5280* (PERTH); near Lake Grace, Sept. 1997, *G.J. Keighery & N. Gibson 5283* (PERTH); NE of Lake King, 16 Nov. 1980, *K.R. Newbey 8030* (NSW, PERTH); SSE of Lake King, 28 Aug. 1973, *M.D. Tindale 3788* (CANB, K, NSW, P, PERTH); S of Lake King, 6 Nov. 1994, *K.L. Wilson 8779 & K. Frank* (NSW, PERTH).

Etymology: Named for Brendan J. Lepschi (1969–), for his enthusiastic support and efforts to tackle curly nomenclatural issues in the Australian flora, and his wide collecting, including this obscure species. He is the author of a number of classic botanical publications including *The taller tree of liff* (Lepschi 2012).

Common name: Lepschi's Tricostularia.

Notes: Occasionally confused with *Schoenus globifer* Nees due to superficial similarities in the plant habit. Only immature and old spikelets have been observed, so several floral and fruiting characters remain poorly known. A few spikelets on *M.D.Tindale 3788* (NSW) are infected by a smut fungus, *Moreaua tricostulariae* (Websdane & Vánky) Vánky (see Vánky and Shivas 2008).

Tricostularia neesii Lehm., *Nov. Stirp. Pug.* 8: 52 (1844).

Chaetospora neesii (Lehm.) Boeckeler, *Linnaea* 38(3): 297 (1874). *Schoenus neesii* (Lehm.) F.Muell., *Syst. Census Austral. Pl.* 1: 128 (1882).

Type citation: "Habitat in Australia occidentali. (Herb. Preiss no. 1728.) Colitur in hort. bot. Hamburg."

Type: Western Australia: Swan River, 1843, [*J.A.*]*L. Preiss* [*Pl. Preissianae No. 1728*] (lectotype (here designated): LD 1730387; isolecto: G-DC 00195297, MEL 2297589, MEL 2297590).

Possible syntype: Cultivated at Hamburg Botanic Garden (?syn: ?HBG, *n.v.*).

Illustration: Wheeler and Graham (2002; fig. p. 298, excluding the two inflorescence figures); Barrett and Pin Tay (2016; pl. 4–6, p. 203).

Perennial tufted herb, 0.5–0.8 m high; plants clonal, forming dense tussocks 0.3–0.8 m across; rhizome thin, woody, short, branched, 0.9–1.6 mm diam., non-pseudobulbous; old leaf sheaths covering the rhizome, not breaking apart into fine fibres with age, pale to reddish brown; roots sand-binding. *Culms* slender, rigid, erect to spreading, usually not noded, but sometimes with 1 or 2 nodes terete, very finely striate, 0.5–1.5 mm diam., smooth, glabrous, bright green to yellow-green, base not enlarged. *Leaves* mostly basal, numerous, and 1 or 2 cauline; phyllotaxy loosely spirotristichous; sheath 12–100 mm long, 0.7–1.5 mm wide, slightly broader than the leaf lamina, margins with just a few very fine scabrid hairs, otherwise glabrous, straw-coloured to reddish brown, dull, upper margin membranous, oblique, ligule absent; cauline sheath tight around culm; *pseudopetiole* obscure or absent; basal leaves with a much reduced lamina, much shorter than the culms, lamina dorsiventral, 3–5 mm long, 0.2–0.4 mm wide; bases pale brown-membranous, not dividing; lamina

± linear, not channelled, ± flexuous, old leaf tips not curling, finely multi-striate, margins sometimes very finely scabrid, otherwise glabrous, green, concolorous, weakly keeled along mid-nerve, margins not recurved, apex attenuate; lowest leaves reduced to a sheath, lacking a lamina, pale to reddish brown. *Inflorescence* much-contracted, panicle-like, narrow-oblate to lanceolate, not flexuous, with 2–4-nodes, 1.5–2.2 cm long, 4–6 mm wide, not interrupted, axis ± fully concealed, green or yellow-green, not glaucous; bracts bract-like, usually shortly exceeding the spikelet clusters, sheaths open, partially enveloping the higher bracts, gradually reducing along the inflorescence, basal bract much shorter than inflorescence, 8–12 mm long; basal branchlet 10–15 mm long, branches erect, with solitary or 2 spikelets per branchlet, spikelet(s) ± sessile or on short, compressed, glabrous peduncles to 0.5 mm long, arising in each bract axil; spikelet prophyll present, sheath 3.1–4.6 mm long, translucent to pale brown or with dark reddish flecks, with distinct mid-vein, partially enclosing the spikelet, with a slender lamina 0.9–1.5 mm long, translucent to pale brown. *Spikelets* translucent to pale brown or with dark reddish flecks, lanceolate, 5.5–6.8 mm long, 1.1–1.7 mm wide, somewhat compressed, with 5 or 6 persistent glumes, only topmost 2 fertile, the lower flower male fertile, the upper flower bisexual, fertile, no reduced glume above the florets; glumes distichous, basal glume 3.6–4.5 mm long, fertile glumes 4.7–5.8 mm long, 0.9–1.3 mm wide, membranous, translucent to pale brown or with dark reddish flecks, very finely ciliate on the keel and margins, the hairs short and spreading, face glabrous, ovate-lanceolate, acuminate, with a mucro 0.6–1.2 mm long, keel distinct; rachilla compact and not sinuous in fruiting spikelets. *Perianth segments* 6, whitish, 0.5–1.2 mm long, ± filiform but dilated at the very base, tapering to a fine point with a few minute hairs at the apex. *Stamens* 3, anther connective 3.1–4.6 mm long, subulate; anthers yellow, 2.7–3.4 mm long, with a glabrous apical appendage 0.4–0.5 mm long. *Style* trifid, base 3.0–3.5 mm long, glabrous, slender above, not or scarcely dilated below, branches 2.4–2.8 mm long, hispidulous. *Nutlet* shortly stipitate, stipe *c*. 0.4 mm long, somewhat constricted, obovoid to obpyriform, obscurely trigonous, dull, mid-brown, 1.9–2.2 mm long including the stipe and style base, 0.8–1.0 mm diam., faces smooth, very minutely puberulous especially near apex, epidermal cells square–hexagonal, inconspicuous, with three fine white ribs, style base not enlarged, cap-like; embryo not examined. Photosynthetic pathway not examined. (Figure 23).

Fig. 23. *Tricostularia neesii*. A. Habit, Armadale, Western Australia. B. Plant base. C. Inflorescences. D. Inflorescence. Vouchers: A, B: *F. Hort & J. Hort 2452* (NSW); C: *J. Pryde & M. Morley MM 12* (NSW). D. Darling Range (not vouchered). Photos by R.L. Barrett.

Diagnostic characters: Distinguished by the relatively short, compact inflorescence and culms with 0, 1 or 2 nodes.

Distribution: Endemic to the south-west of Western Australia where it is widespread, from Eneabba south to Bunbury and east to Ravensthorpe, extending inland along the Avon River and to the Stirling Range.

Habitat: Grows in open shrubland and heath in seasonal wetlands and damplands, usually on sandy loam, sometimes in white or grey sand over laterite. Recorded in association with *Allocasuarina humilis*, *Anarthria laevis*, *A. gracilis*, *Banksia attenuata*, *Byblis gigantea*, *Caustis dioica*, *C. gigas*, *Chordifex microcodon*, *Conostylis* sp., *Corymbia calophylla*, *Eucalyptus accedens*, *E. marginata*, *E. wandoo*, *Hakea ceratophylla*, *H. gilbertii*, *H. prostrata*, *Kingia australis*, *Lepidosperma* aff. *scabrum*, *L.* aff. *squamatum*, *Melaleuca* sp., *Mesomelaena pseudostygia*, *M. tetragona*, *Morelotia australiensis*, *Pericalymma ellipticum*, *Petrophile filifolia*, *Schoenus insolitus*, *S.* sp. Ciliate Sheaths (K Newbey 9402) and *Xanthorrhoea preissii*.

Phenology: Flowers October–December.

Conservation status: Widespread and not considered threatened. Protected in numerous conservation areas including Alexander Morrison National Park and Badgingarra National Park. IUCN: Least Concern.

Selected specimens examined: WESTERN AUSTRALIA: 3.2 km W of Brand Highway on Bibby Road (N side), Badgingarra National Park, 21 Oct. 2008, *R.L. Barrett & B.G. Briggs RLB 5302* (PERTH); Alexander Morrison National Park, 200 m along firebreak which intersects with Coorow–Greenhead Road, 3.4 km E of junction with Tootbardi Road, 17 Nov. 2008, *M. Hislop 3865* (PERTH); Brookton Highway, Armidale, S side of highway, 1.5 km E of Omeo Road, 7 Dec. 2004, *F. Hort & J. Hort 2452* (NSW, PERTH); On W side of Tribune Road, 1 km S of private property boundary. State Forest, *c.* 33 km W of Beverley [Plot YO27], 26 Oct. 2000, *G.J. Keighery & N Gibson 5281* (PERTH); Korijekup Nature Reserve; SE of Harvey, 13 May 2007, *G.J. Keighery & B.J. Keighery 1028* (PERTH); Kelmscott, 20 Nov. 1899, *A. Morrison s.n.* (E 00688606*); Cannington, 21 Nov. 1910, *A. Morrison s.n.* (E 00688607*, NSW 687623); Watkins Plot 3, Watkins Road Bush Forever site, 6 Nov. 2006, *J. Pryde & M. Morley MM 12* (NSW, PERTH); NE corner of Wandoo National Park, N of Dobaderry Road and S of Kokendin Road, 7 Jan. 2008, *M. Wheeler 57* (MEL, PERTH); Alexander Morrison National Park, 30 km E of Brand Highway on the Greenhead to Coorow road, 8 Nov. 1994, *K.L. Wilson 8819 & K. Frank* (NE, NSW, PERTH); Doyle Road, 5.8 km E of junction with Bokal Road South, SW of Arthur River, 6 Oct. 2014, *K.L. Wilson 11267 & A. Wilson* (CANB, K, NE, NSW, PERTH, PRE).

Etymology: Named for Christian Gottfried Daniel Nees von Esenbeck (1776–1858), a German botanist who contributed greatly to the systematics of Cyperaceae (e.g. Nees 1832, 1834, 1835, 1841, 1846).

Common name: Nees' Tricostularia.

Notes: This name has been broadly applied to many of the Western Australian taxa recognised in the genus, particularly any taxa with a slender inflorescence, but the type specimen actually has quite short, compact inflorescences.

A lectotype is selected as the protologue states that material cultivated ('colitur') at Hamburg Botanic Garden was also examined, though no voucher specimen has been traced and it is possible that no voucher was made from the cultivated material. Lehmann probably saw a specimen at either B or S, but we have not located material at either herbarium, so we designate a specimen at LD (LD 1730387) as the lectotype as it is a good specimen in the primary *Plantae Preissianae* set of collections.

Most collections have no nodes on the culms. A few collections have one or rarely two nodes on the culms, and most of these are from the vicinity of the Stirling Range, but a few are from near Perth and the northern Sandplain. Further fieldwork is required to determine whether there is any taxonomic significance to this variation.

Tricostularia newbeyi R.L.Barrett & K.L.Wilson, *sp. nov*.

Type: Western Australia: Dola Reserve, Honey Drive, 2.13 km N of Rabbit Proof Fence road, near North Ongerup telephone exchange, 8 Jan. 2006, *L. Strahan 409* (holo: PERTH 7456336).

Tricostularia sp. Ongerup (L. Strahan 409), *FloraBase* (2008–), accessed 4 June 2020.

Perennial tufted herb, 0.2–0.9 m high; plants clonal, forming dense tussocks 0.2–1 m across; rhizome thin, woody, short, branched, 1.5–2.5 mm diam., non- or slightly pseudobulbous; old leaf sheaths covering the rhizome, not breaking apart into fine fibres with age, pale brown; roots sand-binding. *Stems* slender, rigid, erect to spreading, often arcuate, with 1 (or 2) nodes, terete, very finely striate, 0.5–1.2 mm diam., smooth, glabrous, green to yellow-green, base not enlarged. *Leaves* mostly basal, numerous, and 1 (or 2) cauline; phyllotaxy loosely spirotristichous; sheath 15–25 mm long, 1.2–1.8 mm wide, slightly broader than the leaf lamina, margins with a few minute scabrid hairs, otherwise glabrous, straw-coloured to reddish brown, dull, upper margin membranous, oblique, finely scaberulous, ligule absent; cauline sheath tight around culm; *pseudopetiole* obscure or absent; basal leaves with a much reduced lamina, not exceeding the culms, lamina dorsiventral, 0.1–0.2 cm long, c. 0.05 mm wide; bases white-membranous, not dividing; lamina ± triangular, ± flat, not flexuous, old leaf tips not curling, finely multi-striate, margins finely scaberulous, otherwise glabrous when young, green, concolorous, weakly keeled along mid-nerve, margins ribbed and finely scaberulous, not recurved, apex acute; lowest leaves reduced to a sheath, lacking a lamina, pale brown. *Inflorescence* panicle-like, narrow, somewhat flexuous, with 6–9 nodes, 1.5–6 cm long, 5–8 mm wide, sometimes interrupted, axis green or yellow-green, not glaucous; bracts reduced leaf-like, not exceeding the spikelet clusters, sheaths open, not enveloping the higher bracts, gradually reducing along the inflorescence, basal bract much shorter than inflorescence, 7–13 mm long; branches erect, with (1–)2–4 fasciculate spikelets in 6–9 clusters, spikelets on short, compressed, glabrous peduncles 0.5–1.5 mm long, arising in each bract axil; cladoprophyll subtending each spikelet bract-like, sheath 3.0–4.0 mm long, pale brown to brown, with 3 distinct veins, partially enclosing the spikelet, with a slender lamina 0.7–1.0 mm long, brown. *Spikelets* pale brown to mid-brown, lanceolate, 4.4–5.6 mm long, terete, with 6 or 7 glumes, only topmost 2 fertile, the lower flower bisexual, female sterile, the upper flower bisexual, fertile, with a reduced glume above the florets to 2.3 mm long; glumes distichous, basal glume 2.9–3.4 mm long, fertile glumes 3.5–5.0 mm long, 1.1–1.6 mm wide, membranous, pale brown to mid-brown (apex often darker than body and keel paler yellow-brown), glabrous or finely ciliate on the keel and margins, lamina glabrous, ovate-lanceolate, acuminate, with a mucro to 0.8 mm long, keel distinct; rachilla compact and not or scarcely sinuous in fruiting spikelets. *Perianth segments* 6, whitish, minute, 0.5–1.1 mm long, expanded below, tapering to a fine point with a few stiff apical hairs. *Stamens* 3; anther connective 4.1–5.5 mm long, subulate; anthers yellow, *c.* 2.0 mm long, with a glabrous apical appendage up to 0.3 mm long. *Style* trifid, base 1.5–2.4 mm long, hispidulous and slightly flared in apical third, glabrous and not or scarcely dilated below, branches 1.3–1.6 mm long, hispidulous. *Nutlet* shortly stipitate, stipe *c.* 0.4 mm long, somewhat constricted, obovoid to broad ellipsoid, obscurely trigonous, dull, mid-brown, 1.8–2.0 mm long including the stipe and style base, 1.0–1.3 mm diam., faces smooth, puberulous especially near apex, epidermal cells square–hexagonal, inconspicuous, with three fine white ribs, style base slightly enlarged, thick, persistent, cap-like, *c.* 0.2 mm long; embryo not examined. Photosynthetic pathway not examined. *2n* = unknown. (Figure 24).

Fig. 24. *Tricostularia newbeyi*. Western Australia. A. Habit. B, C. Inflorescence with stamens and old styles. D. Habit. E. Plant base. F. Inflorescences. Voucher: A–C: Starvation Boat Harbour, *G. Byrne 2545* (PERTH); D–F: Near Cocklebiddy, *M.D. Crisp 4775* (NSW). Photos A–C by G. Byrne; D–F by R.L. Barrett.

Diagnostic characters: Closely related to *T. compressa*, differing in the generally taller stature (0.2–0.9 m high), thicker culms with 1(2) nodes, longer inflorescences (1.5–6 cm long) with 6–9 nodes and acute glumes.

Distribution: Endemic to the south-west of Western Australia, from Albany east to Esperance and the Cocklebiddy area.

Habitat: Grows on flat sandplains, gentle slopes or dunes, in deep white, yellow, brown or grey sands, sometimes over clay in winter-wet areas or over laterite or limestone. Recorded in association with *Callitris* sp., *Eremaea* sp., mallee *Eucalyptus* spp., *E. incrassata*, *Gahnia deusta*, *G. lanigera*, *Lepidosperma fairallianum*, *L.* sp. Mount Ridley (K.L. Wilson 9247), *Mesomelaena stygia* ssp. *stygia*, *Morelotia microcarpa*, *Netrostylis* sp. Mt Madden (C.D. Turley 40 BP/897), *Schoenus caespititius* and *S. racemosus*.

Phenology: Flowers October–December.

Conservation status: Recorded as locally common and relatively widespread in a variety of habitats, so not considered threatened. Conserved in a number of conservation reserves including Stirling Range National Park, Cape Arid National Park, Nuytsland Nature Reserve and Dola Reserve. IUCN: Least Concern.

Specimens examined: WESTERN AUSTRALIA: Saddleback Hill, 2 Dec. 2009, *E. Adams & C. Turley EA 615* (PERTH); Plot 5110, Redmond State Forest, N of Hunwick Road, 6 Nov. 1991, *A.R. Annels ARA 1889* (PERTH); 7.2 km SW of Rawlinson Road on West Point Road, 12 Dec. 1983, *M.A. Burgman & C. Layman MAB 2893* (PERTH); 3.8 km N of the Starvation Boat Harbour camping area on Southern Ocean Road, 22 Nov. 2006, *G. Byrne 2545* (PERTH); 20 km SSW of Cocklebiddy along track to Twilight Cove, 4 Jan. 1979. *M.D. Crisp 4775* (CBG, NSW); side of North Woogenilup Road (Flora road), 4 Feb. 1997, *R. Davis 2493* (PERTH); 4.9 km E along Chillinup road from junction of Kojaneerup West Road, 19 Nov. 2013, *R. Davis & M. Davis RD 12395* (PERTH); Quadrat 1, Dolphin Cove Road Tank, Cape Arid National Park, 7 Oct. 2013, *D.J. Edinger & G. Marsh DJE 4094* (PERTH); Stirling Range National Park, survey site SWA0201D, 28 Oct. 2013, *R. Meissner, C. McCormack & M. Langley 6295* (PERTH); Stirling Range National Park, survey site SWA0203B, 31 Oct. 2013, *R. Meissner, C. McCormack & M. Langley 6296* (PERTH); 3.5 km SE of Chillinup Pool, 28 Nov. 1974, *K.R. Newbey 4619* (PERTH); Lot 14, View Range Road, [SE of] Tenterden, 29 Dec. 2007, *J.E. Wajon 1615* (PERTH); SRNP [Stirling Range National Park] C13, Murray site, 1.35 km S of North-East Track on North Isongorup Track. W from road, 8 Dec. 1988, *R.T. Wills 1410* (PERTH); Site SRNP C19, Murray Site, intersection of South Mirlpunda Track and Ellen Track, S from road, 9 Dec. 1988, *R.T. Wills 1411* (PERTH); 20 km S of Cocklebiddy on track to Twilight Cove, 3 Dec. 1994, *K.L. Wilson & K. Frank 9263* (NE, NSW, PERTH).

Etymology: Named in memory of Kenneth Raymond Newbey (1936–1988), a plant ecologist, botanical collector, horticulturalist and farmer from the Ongerup region who collected many new species from southern Western Australia and had a particular interest in Cyperaceae.

Common name: Newbey's Tricostularia.

Notes: While quite widespread, the resemblance of this species to *T. compressa* and presumed variation in that species meant it was overlooked until recent years.

Tricostularia pauciflora (F.Muell.) Benth., *Fl. Austral.* 7: 383 (1878).

Lepidosperma pauciflorum F.Muell., *Fragm*. 9: 23 (1875). *Schoenus pauciflorus* (F.Muell.) F.Muell., *Syst. Cens. Austral. Pl.* 1: 128 (1882).

Type citation: "In planitiebus uliginosis exsiccantibus prope Mount Abrupt, F. Mueller; prope Mount William, Sullivan."

Type: VICTORIA: prope [near] Mt Abrupt, November 1853, *F. Mueller s.n.* (lectotype (designated by Barrett and Wilson 2012: 287): MEL 2295903; isolecto: K 000960122, MEL 2295898, MEL 2295899, MEL 2295900, MEL 2295902).

Residual syntypes: near Mt William, 12 Nov. 1873, *D. Sullivan 14* (syn: K 000960123, MEL 2295901).

Cladium pauciflorum R.Br., *Prodr*. 237 (1810). *Chapelliera pauciflora* (R.Br.) Nees in J.G.C. Lehmann (ed.) *Pl. Preiss*. 2(2–3): 444 (1848). *Cladium junceum* var. *pauciflorum* (R.Br.) Kük., *Rep. Spec. Nov. Regni Veg*. 51: 182 (1942).

Type citation: "(J.) v.v."

Type: New South Wales: Port Jackson, 1 July 1802, *R. Brown* [*Bennett No. 6048*] (syn: BM 000798948, E 00303230*, K 000960124).

Illustrations: Metcalfe (1971; fig. 68a–c); Wilson (1993: fig. 57a–c); Morris (1994: figs 30L, 40).

Perennial tufted herb, 0.1–0.45(–70) m high; plants clonal, forming dense tussocks 0.1–0.3 m across; rhizome thin, woody, short, branched, 1–2 mm diam., non-pseudobulbous; old leaf sheaths covering the rhizome, not breaking apart into fine fibres with age, pale to reddish brown; roots sand-binding. *Culms* slender, rigid, erect, often arcuate, with 1(2) nodes or not noded, terete, not or scarcely grooved, 0.5–1.2 mm diam., smooth, glabrous, green to yellow-green, base somewhat tapering. *Leaves* mostly basal, numerous, and sometimes 1 or 2 cauline; phyllotaxy loosely spirotristichous; sheath 11–17 mm long, 0.7–1.5 mm wide, slightly broader than the leaf lamina, margins glabrous, straw-coloured to dark red-brown, dull, upper margin membranous, oblique, glabrous, ligule absent; cauline sheath tight around culm; *pseudopetiole* obscure or absent; basal leaves often with a much reduced lamina, not exceeding the culms, lamina dorsiventral, 0.5–6(–7) cm long, 0.3–0.7 mm wide; bases not differentiated, not dividing; lamina ± linear, channelled, ± flexuous, old leaf tips not curling, finely multi-striate, margins glabrous or with a few minute scabrosities, otherwise glabrous, brown, concolorous, weakly keeled along mid-nerve, margins not recurved, apex long-attenuate, setaceous; lowest leaves reduced to a sheath, lacking a lamina, pale to reddish brown. *Inflorescence* contracted, panicle-like, narrow, ± obloid, somewhat flexuous, with 0 or 1(2) nodes, 0.8–1.5 cm long, 5–8 mm wide, usually not interrupted, axis green or yellow-green, not glaucous; bracts reduced leaf-like, not exceeding the spikelet clusters, sheaths open, not enveloping the higher bracts, gradually reducing along the inflorescence, basal bract somewhat shorter than inflorescence, to 12 mm long; branch(es) erect, margins scabrous, with solitary or 2 or 3 spikelets in a terminal cluster (rarely with a second distant cluster), spikelet(s) on short, terete, glabrous peduncles 1–3 mm long, arising in each bract axil; spikelet prophyll present, sheath 3–4.5 mm long, brown, with 3 distinct veins, partially enclosing the spikelet, with a slender lamina 0.6–1.0 mm long, brown. *Spikelets* brown, lanceolate, 4–6 mm long, terete, with 5 or 6 glumes, only topmost 2 or 3 fertile, the lower 1 or 2 flowers male, sterile or fertile, the upper flower bisexual, fertile, no reduced glume above the florets; glumes subdistichous, basal glume 2.5–3.5 mm long, fertile glumes 2.9–4.0 mm long, 1.5–2.8 mm wide, membranous, very pale red-brown to very dark red-brown (apex often darker than body), sparsely scabrous on the keel, lamina glabrous, ovate-lanceolate, acute to acuminate, with a mucro to 0.5 mm long, keel distinct; rachilla compact and not sinuous in fruiting spikelets. *Perianth segments* 6, whitish, minute, 0.2–0.8 mm long, expanded below, tapering to a fine point, glabrous, sometimes persistent but usually falling with nutlet. *Stamens* 3; anther connective 2.3–3.8 mm long, subulate; anthers cream, 1.4–1.6 mm long, with a glabrous apical appendage 0.15–0.2 mm long. *Style* trifid, base 0.5–1.2 mm long, glabrous, slender above, not or scarcely dilated below, branches 1.5–2.0 mm long, hispidulous. *Nutlet* shortly stipitate, stipe *c.* 0.5 mm long, somewhat constricted, obovoid to obpyriform or broad ellipsoid, obscurely trigonous, dull, mid-brown to dark brown, 2.1–2.5 mm long including the style base, 1.2–1.5 mm wide, faces smooth, puberulous especially near apex, epidermal cells square–hexagonal, inconspicuous, with three fine white ribs, style base only slightly enlarged, thick, persistent, very shortly conical; embryo not examined. Photosynthetic pathway inferred from anatomy to be C_3 (Takeda *et al.* 1985; *Willis s.n.*, 1 Oct 1959; *Briggs 3961*; Bruhl & Wilson 2007). (Figure 25).

Diagnostic characters: Distinguished from all other *Tricostularia* species by the highly reduced inflorescence with only 1–3 spikelets.

Distribution: South from Limeburners Creek Conservation Reserve in coastal New South Wales, extending inland to the Gibraltar Range and the Blue Mountains. Common in the Gippsland area, then apparently disjunct to Wilsons Promontory, extending west from there through Anglesea, Casterton and the Grampians, to Penola in South Australia. Isolated records in the southern Mount Lofty Ranges, and a single record from Kangaroo Island. Scattered in the north-east and east coast of Tasmania, including Cape Barren Island in the Furneaux group.

Habitat: Grows damp sandy heathlands, open *Eucalyptus* woodland, grasslands and dunes associated with sandstone or granite, mainly in near coastal areas.

Recorded in association with *Allocasuarina distyla*, *A. muelleriana*, *Amperea xiphoclada*, *Anthelepis paludosus*, *Aotus ericoides*, *Astroloma pinifolium*, *Austrostipa mollis*, *Banksia ericifolia*, *B. serrata*, *Burchardia umbellata*, *Caesia parviflora*, *Callitris rhomboidea*, *Calytrix alpestris*, *Caustis flexuosa, C. pentandra*, *Chaetospora turbinata*, *Corymbia gummifera*, *Epacris impressa*, *Eragrostis brownii*, *Eucalyptus baxteri*, *E. haemastoma*, *E. obliqua*, *E. pilularis*, *E. serraensis*, *Gahnia radula*, *G. sieberiana*, *Grevillea aquifolium*, *Hypolaena fastigiata*, *Isopogon ceratophyllus*, *Juncus continuus*, *J. planifolius*, *Laxmannia orientalis*, *Lepidosperma canescens*, *L. concavum*, *L. filiforme*, *L. semiteres*, *L. sieberi*, *Leptospermum attenuatum*, *L. myrsinoides*, *L. polygalifolium*, *L. scoparium*, *Lepyrodia scariosa*, *Lomandra longifolia*, *Lomatia ilicifolia*, *Machaerina acuta*, *Monotoca scoparia*, *Patersonia fragilis*, *Petrophile pulchella*, *Platylobium obtusangulum*, *Poa morrisii*, *Prostanthera saxicola*, *Ptilothrix deusta*, *Schoenus apogon*, *S. brevifolius*, *S. imberbis*, *S. pachylepis*, *Styphelia adscendens*, and *Xanthorrhoea australis*.

Phenology: Flowers recorded for August–December.

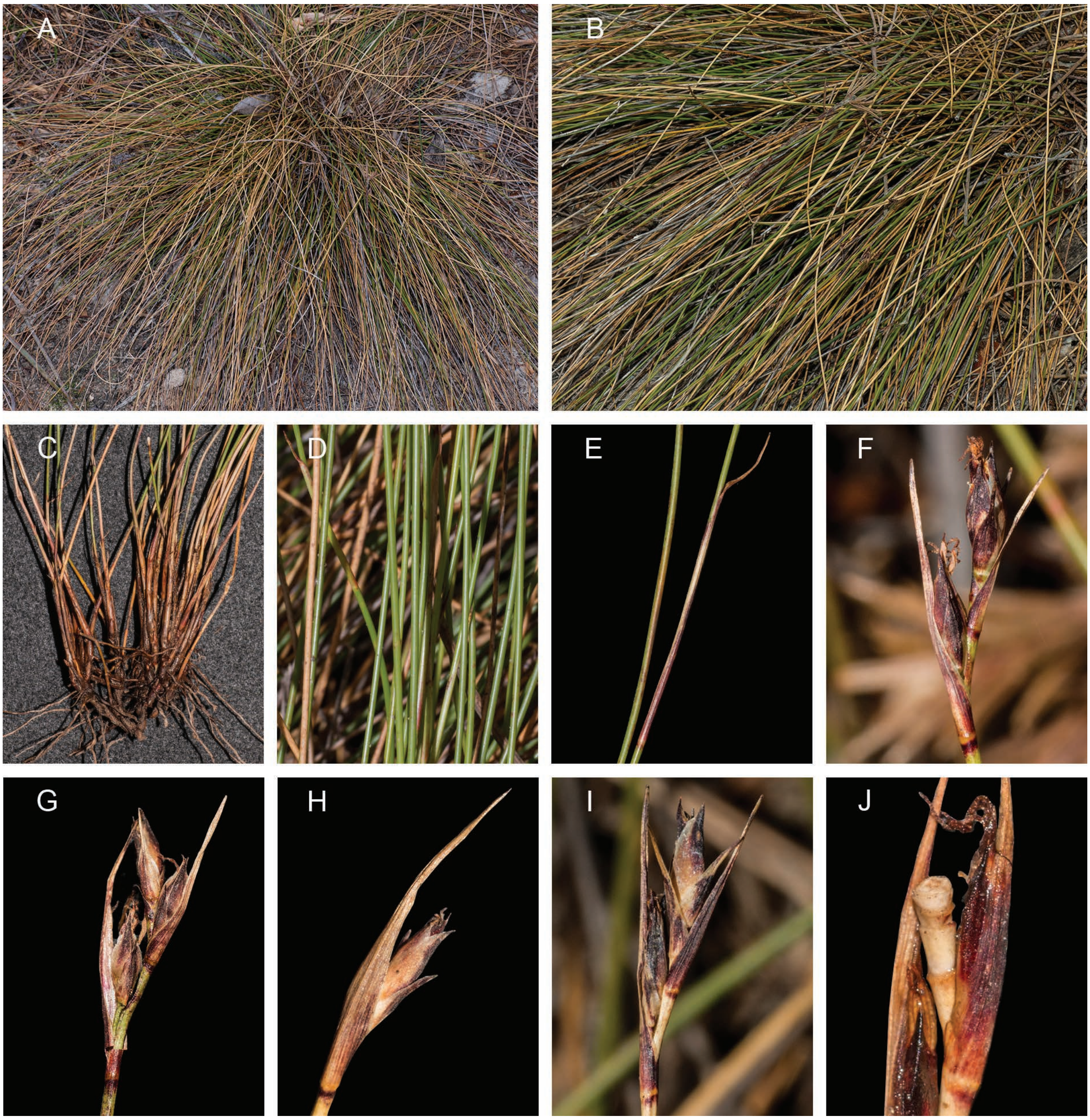

Fig. 25. *Tricostularia pauciflora*. Royal National Park, New South Wales. A, B. Habit. C. Plant base. D. Culms. E. Leaf sheath and reduced lamina. F–I. Inflorescence. J. Rachilla with glumes fallen and persistent inflorescence bract. Voucher: *R.L. Barrett 9313* (NSW); Photos by R.L. Barrett.

Conservation status: Widespread and not threatened as a species. Uncommon east of Port Phillip Bay in Victoria (Wilson 1993). Probably common and widespread throughout the southern Mt Lofty Ranges in South Australia before settlement, but now much reduced (Jessop and Weber 1986). Apparently rare in Tasmania (Morris 1994). IUCN: Least Concern.

Specimens examined: SOUTH AUSTRALIA: Yallum [?Park], 9 miles W of Penola, 15 Dec. 1963, *A.C. Beauglehole ACB 5911* (AD, *n.v.*, MEL); Comaum Nature Forest Reserve, Alcock's Scrub, EW track off NS track adjacent pine plantation, 14 Feb. 2006, *D.J. Duval 390* (AD, *n.v.*, MEL). NEW SOUTH WALES: Mowlee Ridge, E of Bundeena road on Little Marley Track, Royal National Park, 15 Sept. 2020, *R.L. Barrett 9313* (NSW); Manly, Oct. 1894, *E. Betche s.n.* (NSW 687702); Morton National Park, off track to Tianjara Falls carpark, N of Nerriga (Turpentine) Rd, 31 Dec. 2008, *J.J. Bruhl & F.C. Quinn 2701* (BOL, BRI, CANB, EIU, K, NE, NSW); near western boundary of Gibraltar Range National Park, park along Gwydir Highway between Glen Innes and Grafton, 21 Oct. 1988, *S. Krauss 113* (NSW); Ku-ring-gai Chase National Park, Dark Hole track, 25 Apr. 2009, *P.M. Musili, J.J.Bruhl & K.L. Wilson 534A* (BRI, EA, K, NE, NSW, PERTH); Topham Track, W of West Head Road, Ku-ring-gai Chase National Park, 28 Nov. 1990, *K.L. Wilson 7654* (K, NSW, P); Mowlee Ridge, E of Bundeena road on Little Marley Track, Royal National Park, 28 Nov. 2012, *K.L. Wilson & O. Yano 10941* (NE, NSW). VICTORIA: on E side of Grampians Tourist Road, *c.* 29 km S. of Halls Gap, Grampians

National Park, 5 Oct. 2008, *R.L. Barrett RLB 5222* (PERTH); 7 miles [12 km] E of Vic./S.A. border, N side of Dergholm–Penola road, 9 Nov. 1964, *A.C. Beauglehole ACB 16333* (AD, CANB, LTB, *n.v.*, MEL, NE, NSW); lower western slopes of Mt Abrupt, by roadside N of walking track to summit, 28 Oct. 1995, *I.C. Clarke 2615* (CANB, MEL); SE of Portland, Alcoa smelter site, 1.1 km SW of Blacknose Point, 18 Nov. 1980, *M.D. Crisp 6900* (CBG, NSW); 1.2 km from Knights Bridge over the Wannon River, Dunkeld-Halls Gap Road, roadside verge, E side, 29 Dec. 2008, *A.K. Gibbs & A.R. Fitzpatrick 88* (BRI, K, MEL, NE, NSW); Anglesea, Shining Eye Track. Grid P 20, 22 Dec. 1990, *V. Stajsic 110* (HO, *n.v.*, MEL, NSW); Black Rock, Royal Melbourne Golf Club, 15 Dec. 2016, *V. Stajsic, S.J. Moodie & J. Stewart 8322* (NE, MEL). TASMANIA: Waldheim, 27 Jan. 1962, *M.E. Phillips 461* (CBG); *c.* 2 km NW of Coles Bay on Bicheno road, 21 Feb. 1986, *K.L. Wilson 6517* (HO, NSW).

Etymology: From the Latin *pauci-* (few) and *-florus* (flowered).

Common name: Needle bog-rush.

Notes: This is the only species in the genus in south-eastern Australia. There are some particularly small forms in Victoria that warrant further study.

Cladium pauciflorum R.Br. (Brown 1810) was published well before *Lepidosperma pauciflorum* F.Muell. (Mueller 1875), the two names were regularly treated as belonging to discrete taxa and often placed in separate genera (e.g. Mueller (1875: 16) where Brown's name was treated as a synonym of *Cladium junceum* R.Br. (=*Machaerina juncea* (R.Br) T.Koyama)). Bentham (1878) combined Mueller's name in *Tricostularia*, while treating Brown's name as a probable variety of *Cladium junceum*. Brown's name therefore cannot be transferred to *Tricostularia* as it would be a later homonym.

Tricostularia sandifordiana R.L.Barrett & K.L.Wilson, *sp. nov*.

Type: Western Australia: access track to Granite Hill Nature Reserve, 1.4 km E of Moorialup Road at junction of minor track, 16 Nov. 2003, *M. Hislop 3092* (holo: NSW; iso: PERTH 06701809).

Tricostularia sp. South Coast (R.T. Wills 1423), *FloraBase* (2008–), accessed 4 June 2020.

Perennial herb, 0.3–0.9 m high; plants clonal, 0.5–2 m across, culms widely spaced along rhizomes; rhizome thin, woody, very long, branched, 0.8–1.8 mm diam., not pseudobulbous; old leaf sheaths covering the rhizome, partly breaking apart into fibres with age, straw-coloured or pale brown; roots sand-binding. *Culms* slender, rigid, erect, with 2–5 nodes, ± terete, sometimes drying irregularly angular, very finely striate, 0.7–1.7 mm diam., smooth, glabrous, bright green to yellow-green, base not enlarged. *Leaves* greatly reduced, 2–5, cauline; phyllotaxy loosely spirotristichous; sheath 9–21 mm long, 1.7–3.3 mm wide, flared open at the apex and broader than the leaf lamina, margins glabrous, brown to dark red-brown, dull, upper margin somewhat membranous, prominently auriculate, oblique, glabrous, ligule absent; sheath tight around culm; *pseudopetiole* obscure or absent; cauline leaves with a much reduced lamina, not exceeding the culms, lamina dorsiventral, 0.6–1.1 cm long, 0.6–0.9 mm wide; bases not differentiated, not dividing; lamina ± linear, channelled, ± flexuous, old leaf tips not curling, finely multi-striate, margins finely scabrid, otherwise glabrous, green, concolorous, not keeled along mid-nerve, with 3 fine impressed nerves, margins ribbed and finely scabrous, not recurved, apex long-attenuate, acute; lowest leaves reduced to a sheath and lacking a lamina or with a short lamina to 3.5 mm long, straw-coloured or pale brown. *Inflorescence* contracted, panicle-like, narrow, not flexuous, with 0 or 1 nodes, 1.7–4.5 cm long, 10–17 mm wide, commonly interrupted, axis green or yellow-green, not glaucous; bracts reduced leaf-like, not exceeding the spikelet clusters, sheaths open, not enveloping the higher bracts, gradually reducing along the inflorescence, basal bract shorter than inflorescence, 17.1–18.8 mm long; branches erect, with 2–5 spikelets per cluster in a terminal or two distant clusters, spikelet(s) on short, slightly compressed, glabrous peduncles 1–3.5 mm long, arising in each bract axil; basal branch 8–12 mm long; spikelet prophyll present, broad, sheath 6.8–8.2 mm long, apex auriculate, brown, with raised keel, partially enclosing the spikelet, with a slender lamina 0.8–2.4 mm long, brown or green. *Spikelets* brown, lanceolate, 8–10 mm long, 1.4–2.0 mm wide, compressed, with 7 developed glumes and two highly reduced basal glumes, only topmost 2 fertile, the lower flower male fertile, the upper flower bisexual, fertile, no reduced glume above the florets; glumes distichous, reduced basal glumes 1.6–2.1 mm long, translucent, lowest developed glume 3.6–3.9 mm long, fertile glumes 6.3–9.8 mm long, 1.5–2.8 mm wide, membranous, straw-coloured to very pale red-brown (apex often darker than body), finely scabrous on the keel and sometimes on the upper margins, otherwise glabrous, ovate-lanceolate, acute, sometimes with a mucro to 0.5 mm long, keel distinct; rachilla compact and not or scarcely sinuous in fruiting spikelets. *Perianth segments* 6, whitish, minute, *c.* 0.6 mm long, expanded below, tapering to a fine point. *Stamens* 3; anther connective 3.1–3.6 mm long, subulate; anthers yellow, 4.2–4.6 mm long, with a glabrous apical appendage up to 0.9 mm long. *Style* trifid, base 2.3–3.2 mm long, hispidulous and slender above, scarcely dilated below, branches 2.1–2.9 mm long, hispidulous. *Nutlet* [not seen fully mature] shortly stipitate, stipe *c.* 0.3 mm long, somewhat constricted, narrowly ovoid, obscurely trigonous, dull, mid-brown, 1.7–2.1 mm long including the stipe and style base, 0.8–1.1 mm diam., faces smooth, glabrous, apex smooth, glabrous, epidermal cells ovate–hexagonal, inconspicuous, with three fine white ribs, style base only slightly enlarged, thin, persistent, cap-like; embryo not examined. Photosynthetic pathway not examined. (Figure 26).

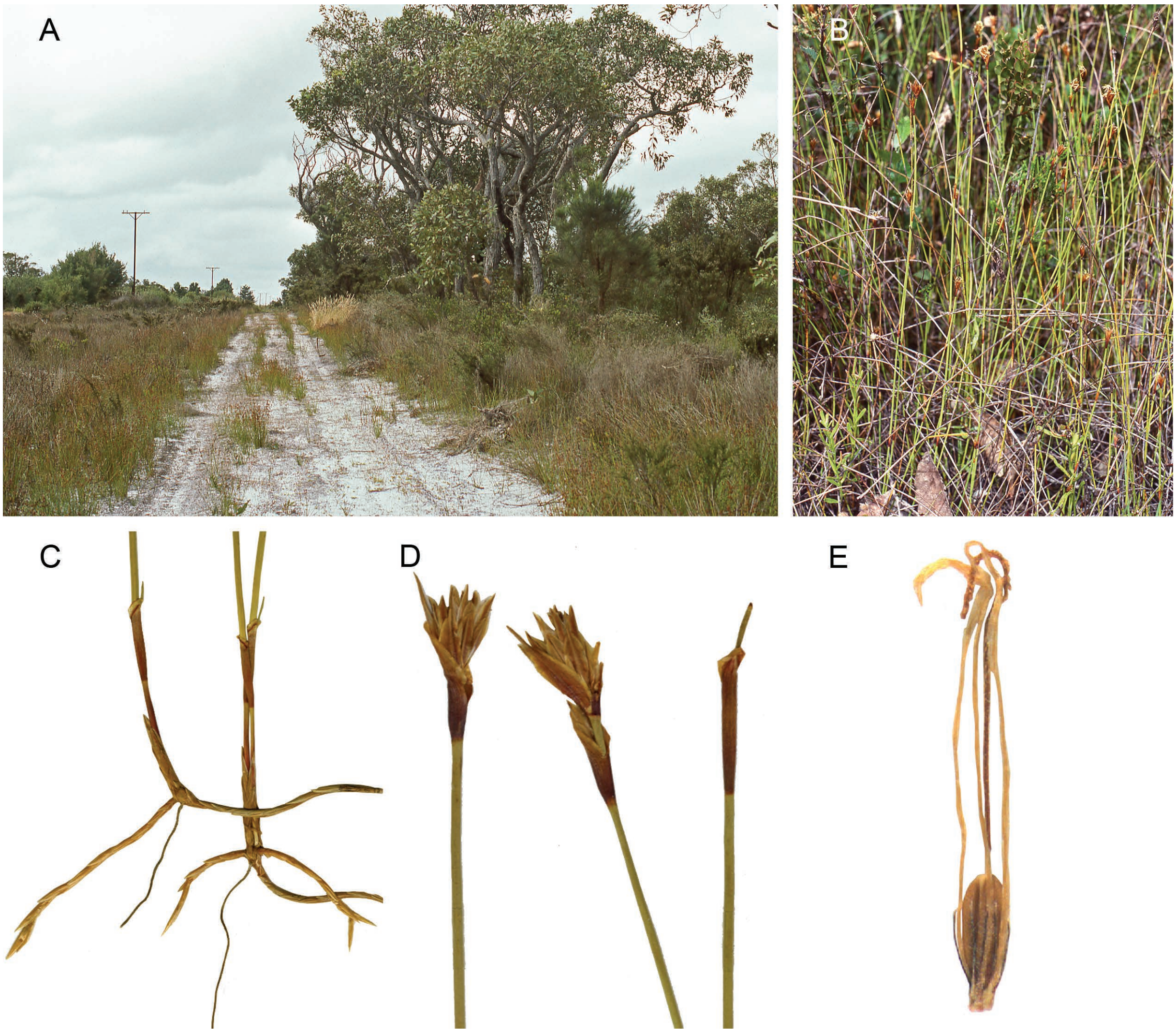

Fig. 26. *Tricostularia sandifordiana*. A. Habitat. B. Habit. C. Plant base. D. Inflorescences (two left) and cauline leaf with flared sheath apex (right). E. Immature nutlet with staminal filaments and style attached. Western Australia. Voucher: *R.T. Wills 1423* (PERTH). Images A, B by K.L. Wilson; C, D by A. Curtis; E by R. Davis.

Diagnostic characters: The widely spreading rhizomes bearing distant culms and broadly flared leaf sheaths and inflorescence bracts are not shared by any other *Tricostularia* species.

Distribution: Endemic to the south-west of Western Australia, between Albany and the Stirling Range.

Habitat: Grows in low heath and *Banksia coccinea* shrubland (Sandiford and Barrett 2010), on winter-wet white or grey sands on plains or gentle slopes, sometimes along drainage lines. Recorded in association with *Adenanthos cuneatus*, *A. obovatus*, *Agonis theiformis*, *Allocasuarina decussata*, *A. fraseriana*, *Anarthria gracilis*, *A. prolifera*, *A. scabra*, *Andersonia micrantha*, *A. pinaster*, *Banksia attenuata*, *B. baxteri*, *coccinea*, *B. grandis*, *B. ilicifolia*, *B. nutans*, *Callistemon glaucus*, *Calytrix flavescens*, *Caustis dioica*, *Chaetospora curvifolia*, *Conospermum caeruleum*, *Conostylis serrulata*, *Corymbia calophylla*, *Cyathochaeta avenacea*, *C. clandestina*, *C. equitans*, *Dasypogon bromeliifolius*, *Eucalyptus cornuta*, *E. marginata*, *E. staeri*, *Harperia confertospicata*, *Hypocalymma strictum*, *Hypolaena exsulca*, *Jacksonia spinosa*, *Johnsonia* sp., *Kunzea ericifolia, Lepidosperma drummondii*, *L.* aff. *squamatum*, *L.* sp. Torndirrup (B. Muir 73), *Leptocarpus tenax*, *Leucopogon elegans*, *L. flavescens*, *L. glabellus*, *Lyginia barbata*, *Lysinema ciliatum*, *Melaleuca striata*, *M. thymoides*, *Mesomelaena tetragona*, *Pericalymma ellipticum*, *Petrophile rigida*, *Phlebocarya ciliata*, *Phyllota barbata*, *Pimelea longifolia*, *Platysace pendula*, *Schoenus caespititius*, *S. efoliatus*, *S. sublateralis*, *Stylidium scandens*, *Taxandria angustifolia*, *T. parvifolia*, *Tremulina tremuloides*, *Tricostularia drummondii* and *Xanthosia rotundifolia*.

Phenology: Flowers recorded for November–December. Immature fruit present in December.

Conservation status: The twelve collections are from nine locations between Redmond (north of Albany) and Isongorup Peak in the Stirling Range. While plants are locally relatively common, population size is probably relatively small due to the extensive clonal nature of this species. One population is known from Phillips Brook Nature Reserve and two from the Stirling Range National Park, while four are on private property and two are in roadside remnants.

Specimens examined: WESTERN AUSTRALIA: Phillips Brook Nature Reserve (on W side of Albany Highway, entrance opposite Millbrook Road), NW of Albany, 22 May 2008, *R.L. Barrett & B.R. Gaskell RLB 5045* (PERTH); SW corner of Bloxidge Road and Pfeiffer Road, South Stirling (*c.* 22 km N of South Coast Hwy from Manypeaks Store), 22 May 2008, *R.L. Barrett RLB 5046* (PERTH); Millbrook Road, 4.0 km E of Albany Highway, in valley above estuary, 28 Oct. 2008, *R.L. Barrett & K.L. Wilson RLB 5360* (PERTH); 1.2 km W of junction of Chokerup Siding Road and Chokerup Road, Walpole Region, 10 Mar. 1997, *N. Casson & K. Kershaw W 169.17* (PERTH); bushland remnant, SE corner Plantagenet Loc 5873, Palmdale Road, South Stirling Plains, 5 Nov. 2002, *E.M. Sandiford EMS 659* (PERTH); remnant vegetation, Plantagenet Loc 6144, Woogenilup North Road, S of the Stirling Ranges, 9 Nov. 2002, *E.M. Sandiford EMS 672* (PERTH); remnant vegetation, Plantagenet Loc. 5951, ITC Gunnamatta Tree Farm, Johnson Road, N of Manypeaks, 10 June 2003, *E.M. Sandiford EMS 793* (PERTH, NSW); remnant vegetation Plantagenet Loc 5193, ITC Chorkerup Tree Farm, Chorkerup Road, Chorkerup Siding, 8 Aug. 2003, *E.M. Sandiford EMS 851* (PERTH); northern end of South Talyuberlup Track, Stirling Range National Park, 11 Nov. 2004, *E.M. Sandiford EMS 987* (PERTH); Phillips Brook Nature Reserve, Albany Hwy, NW of Albany, 8 Nov. 2007, *E.M. Sandiford 1350* (PERTH); Site SRNP [Stirling Range National Park] C13, Murray site, 1.35 km S of North-East Track on North Isongorup Track, W from road, 8 Dec. 1988, *R.T. Wills 1423* (PERTH); Millbrook Nature Reserve, *c.* 450 m along track S of NW corner of reserve, 26 Nov. 1994, *K.L. Wilson & K. Frank 9072* (NSW); Millbrook Nature Reserve, just inside NW corner of reserve, 26 Nov. 1994, *K.L. Wilson & K. Frank 9082* (NSW); 0.5 km N of Redmond–Hay River Road on Chorkerup Road, 26 Nov. 1994, *K.L. Wilson & K. Frank 9087* (NSW); 0.4 km N of Redmond intersection on Chorkerup Siding road, 10 May 1995, *K.L. Wilson 9349* (NSW).

Etymology: Named in honour of Elizabeth (Libby) M. Sandiford and her work in documenting plant diversity in southern Western Australia, particularly in the Albany region (e.g. Sandiford and Barrett 2010; Wilkins and Sandiford 2020). The name is also a play on the common habitat of this species in sandy, seasonally wet areas, 'ford' being a water-crossing.

Common name: Sandiford's Tricostularia.

Notes: The plant habit has a remarkable resemblance to some species of Restionaceae due to the multi-noded culms with large, flared bracts. The erect culms that are widely spaced on the rhizome also give a distinctive appearance similar to a number of south-west Australian species of Restionaceae. Several collections have been determined as Restionaceae sp. in the field, and one collection was even sent to Restionaceae expert Barbara Briggs for determination. The flared apex of the bracts is particularly similar in appearance to those of *Lepidobolus* Nees, and the compact inflorescence is also not dissimilar.

Noted to resprout and able to develop fertile growth within two years following fire.

Tricostularia sp. Albany (R.L. Barrett & K.L. Wilson RLB 5342)

Diagnostic characters: Similar to *T. drummondii* and *T. exsul*, differing in the intermediate inflorescence length, 5–8 cm long (3–4 cm long for *T. drummondii*; 8–12 cm long for *T. exsul*). (Figure 27).

Distribution: Endemic to the south-west of Western Australia, along the south coast between Scott River and Fitzgerald River.

Habitat: Grows in a variety of soils, from deep white or grey sands in winter wet depressions, sand over laterite, brown sandy clay over clay-granite, or dark brown loam, on plains or gentle slopes. Recorded in association with *Allocasuarina humilis*, *Anarthria scabra*, *Aphelia brizula*, *Banksia formosa*, *Baxteria australis*, *Beaufortia decussata*, *Centrolepis strigosa*, *Chaetospora subbulbosa*, *Corymbia calophylla*, *Eucalyptus marginata*, *Evandra aristata*, *Lepidosperma drummondii*, *L.* cf. *pubisquameum*, *Melaleuca thymoides*, *Phyllangium paradoxum*, Restionaceae, *Schoenus acuminatus*, *S. caespititius*, *S. discifer*, *S. lanatus*, *S. obtusifolius*, *S. racemosus*, *S. rodwayanus*, *S. sublateralis*, *S.* sp. Grey Rhizome (K.L. Wilson 2922) and *Tricostularia exsul*.

Phenology: Flowers recorded for September–October.

Conservation status: Relatively widespread and locally common. IUCN: Least Concern.

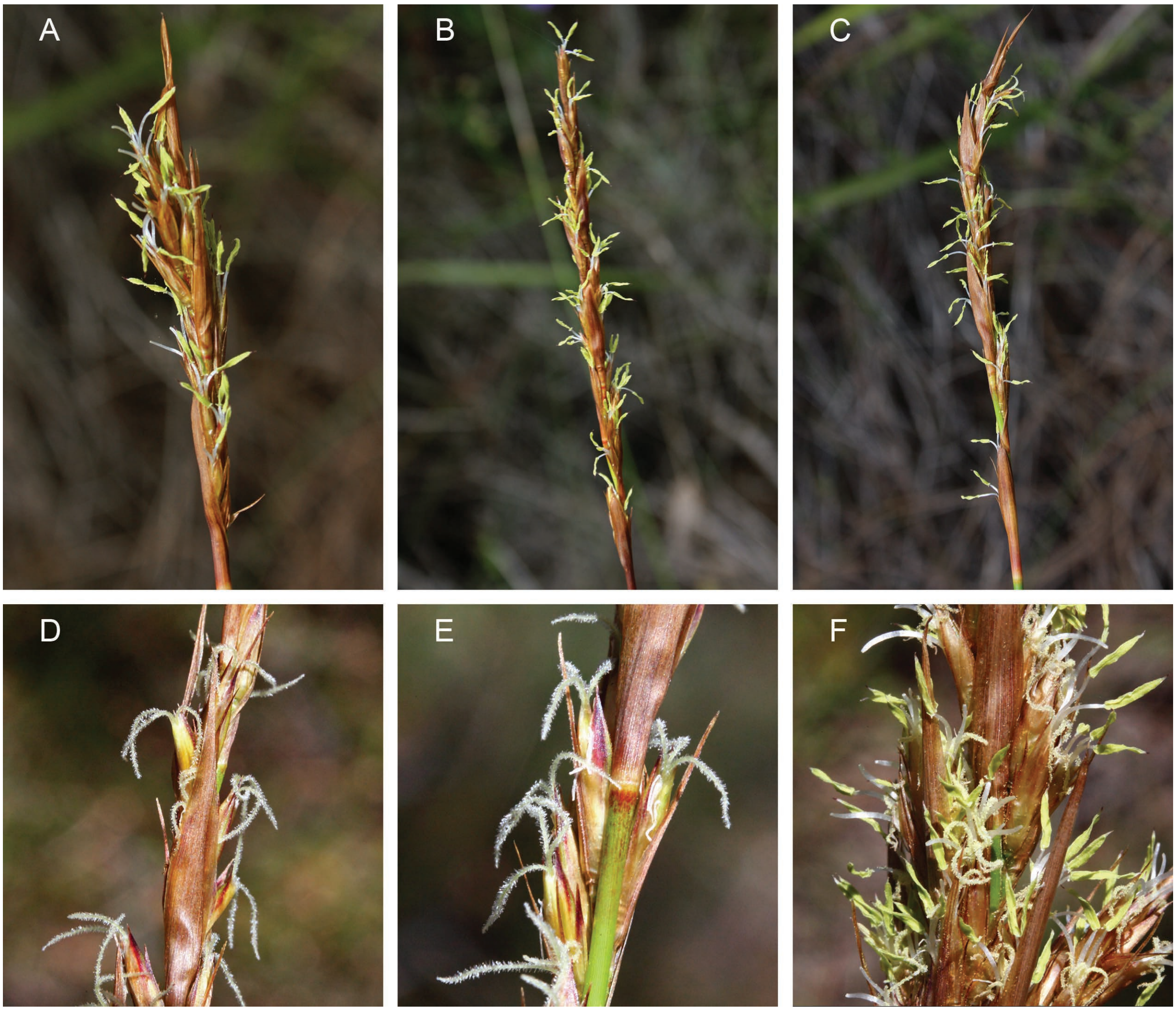

Fig. 27. *Tricostularia* sp. Albany (R.L. Barrett & K.L. Wilson RLB 5342). Bayonet Head, Western Australia. A–C. Full inflorescence with fresh stamens and a few styles. D, E. Spikelets with fresh styles. F. Spikelets with fresh anthers and a few styles. Voucher: *G. Byrne 4509* (PERTH). Photos by G. Byrne.

Specimens examined: WESTERN AUSTRALIA: Albany, 5 Jan. 1903, *C.R.P. Andrews 1153* (K, PERTH [as *s.n.*]); near corner of Roe and Western road, Manjimup, 7 Mar. 1990, *A.R. Annels 1113* (PERTH); Plot 5150, in Scout Reserve, 6.5 km SE of Mt Barker, 21 Sept. 1993, *A.R. Annels 3765* (PERTH); *c.* 1 km N on Gairdner South Road from Borden Bremer Bay Rd, W of Bremer Bay townsite, 7 Feb. 2008, *R.L. Barrett, M. Moody & N. McQuoid RLB 4389* (PERTH); *c.* 300 m down sand track from Albany Speedway, on S side of Albany Highway, 28 Oct. 2008, *R.L. Barrett & K.L. Wilson RLB 5342* (PERTH); Bushland NW of Lower King Road, Bayonet Head, 1 Dec. 2012, *G. Byrne 4509* (PERTH); Fitzgerald River National Park, 200 m W of Hamersley Drive on Hamersley Inlet Road, 20 Jan. 2010, *G.F. Craig 8682* (PERTH); 9 km ENE of Wellstead, 21 Jan. 1997, *R. Davis 2135* (PERTH); Nornalup Road, 23 km S of Mount Barker-Manjimup road, 21 Jan. 1998, *R. Davis 4869* (PERTH); 3 km NE of Bitter Water Swamp, Fitzgerald River National Park, 11 Nov. 1973, *K.R. Newbey 3997* (PERTH); 17 km N of Cape Riche, 30 Nov. 1975, *K.R. Newbey 4935* (PERTH); Lower King River, 1 Feb. 1993, *L.J. Pen LJP 304* (PERTH); Scott River Road, *c.* 4 km W of intersection with Milyeannup Coast Road, Scott National Park, 20 Nov. 1994, *K.L. Wilson 8973* (NSW, PERTH); Millbrook Nature Reserve, *c.* 600 m S along track from NW corner of reserve, 26 Nov. 1994, *K.L. Wilson 9077* (NE, NSW, PERTH).

Notes: Known to co-occur with *T. exsul*, and clearly distinct from that species, but the relationships between *T. exsul*, *T*. sp. Albany and *T. drummondii* would benefit from further clarification. Morphological variation in *T. drummondii* in particular is poorly understood, but molecular data suggest that all three taxa represent distinct lineages (Figure 3).

Tricostularia sp. Mogumber (A. Harris s.n., 23/12/2015)

Diagnostic characters: Superficially similar to *T. davisii*, but probably more closely allied to *T. neesii*, distinctive for its tall culms and sub-capitate heads. (Figure 28).

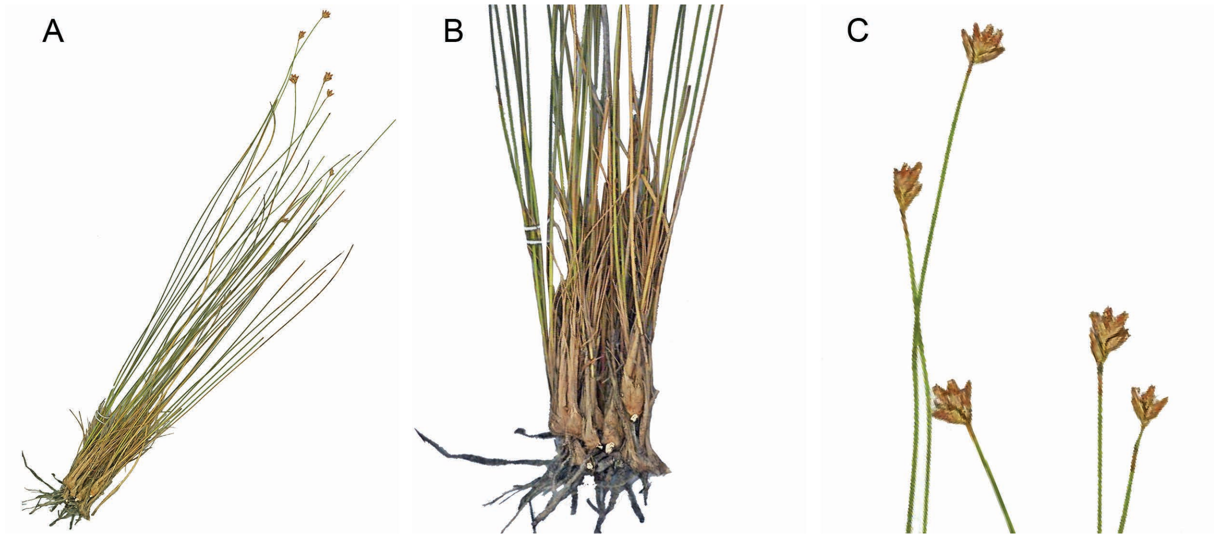

Fig. 28. *Tricostularia* sp. Mogumber (A.J. Harris s.n.; 23/12/2005). Near Mogumber, Western Australia. A. Habit. B. Plant base. C. Inflorescences. Voucher: *A.J. Harris s.n.*; 23 Dec. 2005). Images by A. Harris.

Distribution: Endemic to the south-west of Western Australia, between Mogumber and Lesueur National Park.

Habitat: Grows in low heath or open *Banksia* woodland on white or grey sand. Recorded in association with *Adenanthos cygnorum*, *Alexgeorgea nitens*, *Allocasuarina humilis*, *Banksia attenuata*, *B. dallanneyi* subsp. *pollosta*, *B. mimica*, *B. polycephala*, *Caustis dioica*, *Daviesia physodes*, *Desmocladus virgatus*, *Eucalyptus todtiana*, *Gastrolobium capitatum*, *Harperia lateriflora*, *Hibbertia subvaginata*, *Jacksonia floribunda*, *Lambertia multiflora*, *Lyginia barbata*, *Mesomelaena pseudostygia*, *Nuytsia floribunda*, *Patersonia occidentalis*, *Petrophile divaricata*, *Podotheca angustifolia*, *P. gnaphalioides*, *Scholtzia involucrata* and *Synaphea spinulosa*.

Phenology: Flowers probably in spring.

Conservation status: Poorly known and further conservation assessments are required. IUCN: Data Deficient.

Specimens examined: WESTERN AUSTRALIA: Lesueur National Park, Peron slopes on access firebreaks, Hill River 1:100,000 Grid. ref. 205677, Jan. 1993, *B. Evans 459* (PERTH); near Mogumber, 23 Dec. 2015, *A. Harris s.n.* (PERTH*).

Notes: Previously overlooked and confused with *T. neesii* which is probably the closest relative, differing in inflorescence structure. Further collections are required to assess the status of this taxon.

Tricostularia sp. Porongurup (I. Abbott 18)

Diagnostic characters: The twisted culms and large spikelets (7–9 mm long) are very distinctive. (Figure 29).

Distribution: Endemic to the south-west of Western Australia, known only from a single collection on the south side of the Porongurup Range.

Habitat: Grows in woodland over dense heath. Recorded in association with *Acacia drummondii* subsp. *elegans*, *Agonis theiformis*, *Anarthria laevis*, *Andersonia caerulea*, *Apium prostratum* subsp. *phillipii*, *Astartea scoparia*, *Banksia grandis*, *Beaufortia empetrifolia*, *Boronia crenulata*, *Bossiaea linophylla*, *Chaetospora subbulbosa*, *Darwinia citriodora*, *D. vestita*, *Desmocladus fasciculatus*, *Eutaxia myrtifolia*, *Evandra aristata*, *Kingia australis*, *Kunzea micrantha*, *Leptospermum spinescens*, *Lepyrdia monoica*, *Leucopogon glabellus*, *L. interstans*, *Lysinema pentapetalum*, *Melaleuca blaeriifolia*, *Mesomelaena tetragona*, *Microlaena stipoides*, *Mirbelia dilatata*, *Petrophile teretifolia*, Restionaceae, *Sonchus hydrophyllus*, *Stylidium crassifolium*, *Taxandria angustifolia*, *T. conspicua*, *T. linearifolia*, *Tremandra stelligera* and *Xanthosia rotundifolia*.

Phenology: Flowers not recorded, probably October–November.

Conservation status: The single known collection suggests this species may be localised, or it may simply have been overlooked. The collection was made on private land just south of the Porongurup National Park. IUCN Data Deficient.

Specimen examined: WESTERN AUSTRALIA: South side of Porongurup Range, Mira Flores Estate, Sept. 1975, *I. Abbott 18* (PERTH).

Fig. 29. *Tricostularia* sp. Porongurup (I. Abbott 18). Porongurup South, Western Australia. Voucher: *I. Abbott 18* (PERTH). Photos by R.L. Barrett.

Notes: Efforts to relocate the taxon at the original site by the first author have proven unsuccessful to date; however, the vegetation is largely intact, so it should still be present. It may be more obvious following fire as the vegetative ground cover was very dense at the time the survey to relocate the taxon was conducted.

Morphologically similar to *T. aphylla*, but markedly disjunct and easily distinguished by the more slender culms and larger spikelets.

Tricostularia sp. Two Peoples Bay (G. Wardell-Johnson GWJ 114)

Diagnostic characters: Similar to *T. exsul*, differing in the more slender culms (0.6–1 mm diam.) and the spikelets that are distant on the inflorescence axis and so usually do not overlap. (Figure 30).

Fig. 30. *Tricostularia* sp. Two Peoples Bay (G. Wardell-Johnson GWJ 114). A. Habit at Two Peoples Bay, Western Australia. Voucher: *G. Wardell-Johnson GWJ 114* (NSW). Photos by R.L. Barrett.

Distribution: Endemic to the south-west of Western Australia and only known from two locations, near Two Peoples Bay, east of Albany, and near Bremer Bay.

Habitat: Grows in sand amongst granite boulders on a slope and on exposed plains in well-drained deep white sand. Recorded in association with *Acacia browniana*, *A. leioderma*, *A. robiniae*, *Agonis theiformis*, *Allocasuarina humilis*, *Anarthria gracilis*, *A. prolifera*, *A. scabra*, *Banksia formosa*, *B. gardneri*, *B. mucronulata*, *B. nutans*, *Boronia crenulata*, *B. spathulata*, *Conospermum caeruleum*, *C. teretifolium*, *Corymbia ficifolia*, *Crowea angustifolia*, *Daviesia incrassata*, *Gastrolobium coriaceum*, *Grevillea pulchella*, *Hakea ceratophylla*, *Jacksonia spinosa*, *Lepidosperma drummondii*, *L. leptostachyum*, *Lepyrodia hermaphrodita*, *Leucopogon elegans*, *L. obovatus*, *L. verticillatus*, *Lomandra nigricans*, *L. pauciflora*, *L. sonderi*, *Lyginia barbata*, *Lysinema pentapetalum*, *Melaleuca diosmifolia*, *M. thymoides*, *Morelotia octandra*, *Patersonia umbrosa*, *Petrophile divaricata*, *P. diversifolia*, *Phlebocarya ciliata*, *Schoenus caespititius*, *S. sublateralis*, *Stirlingia tenuifolia* and *Xanthosia rotundifolia*.

Phenology: Flowers probably in spring.

Conservation status: Poorly known and further surveys are required. IUCN Data Deficient.

Specimens examined: WESTERN AUSTRALIA: 2.5 km NNE of Toolalup Swamp (Bremer Bay area), 3 Dec. 1975, *K.R. Newbey 4633* (NSW, PERTH); Plot 5455, W of Bettys Beach on Two Peoples Bay, Boulder Hill, 2 May 1992, *G. Wardell-Johnson GWJ 114* (NSW, PERTH).

Notes: Previously confused with *T. exsul*. Possibly just an extreme form of *T*. sp. Albany (R.L. Barrett & K.L. Wilson RLB 5342), but further fieldwork is required to determine the extent of variation in both taxa.

Xyroschoenus Larridon, *Mol. Phyl. Evol.* 127: 207 (2018).

Type species: *Xyroschoenus hornei* (C.B.Clarke) Larridon.

Perennial tufted *herbs*, 0.9–1.5(–2) m high; plants clonal, 0.3–1 m across; rhizome thick, woody, short, branched, 20–50 mm diam., not pseudobulbous, ultimately forming an erect caudex; old leaf sheaths covering the rhizome, sometimes breaking apart into fibres with age, reddish brown to dark brown; roots not sand-binding. *Culms* (above rosette) stout, erect, with 5–10 leafy nodes, obtusely trigonous, 3–9 mm diam., green, smooth, glabrous, base not enlarged. *Leaves* mostly basal, numerous, and 5–10 cauline; phyllotaxy loosely spirotristichous, sheath glabrous, open, 30–60 mm long, 20–30 mm wide, broader than the leaf lamina, brown, upper margin not membranous, ligule absent; basal leaves 50–90 cm long, (5–)10–15 mm wide, lamina dorsiventral, ± linear, coriaceous, curved, finely multi-striate, scabrid below on acute midrib, yellow-green, green, or sometimes dark green, slightly paler below, margins harshly scabrous to denticulate, sometimes splitting into fibres with age, revolute with age, apex gradually attenuate; cauline leaf lamina 20–50 cm long. *Inflorescence* open, panicle-like, spreading, lanceolate to ovate, 45–60 cm long, 10–55 cm wide, with 8–12 fertile nodes; axis green; bracts leaf-like, coriaceous, smooth, with reddish brown sheaths 20–25 mm long, becoming progressively smaller up the culm, shorter than the branchlets, basal bract usually much shorter than inflorescence; branchlets numerous, 8–25 cm long, arcuate downwards, solitary in lower part of inflorescence, the upper ones in groups of 4 or 5, arising in each bract axil, greatly exceeding the bract sheath; spikelets solitary on peduncles 3–8 mm long; spikelet prophyll subtending each spikelet glume-like, sheath 1.5–2.2 mm long, brown, partially enclosing the spikelet, with a slender lamina 3.1–4.5 mm long, brown. *Spikelets* very numerous, brown to dark brown, oblate to lanceolate, 5–8 mm long, 1.5–2 mm diam., acute, pendant to spreading, subterete, not compressed, with 7–9 glumes, the upper 2 larger glumes each subtending a flower, lower flower male, sterile, upper bisexual, fertile, lower 5–7 glumes empty, glumes distichous, membranous, lower glumes caducous, lowest glume 2.5 mm long, upper glumes 5–6 mm long, 1.8–2.6 mm wide, hispidulous when young, glabrescent, lanceolate, cuspidate, keeled; rachilla elongated and incurved to sinuous between the two flowers, in fruiting spikelets flattened, 3-ribbed. *Perianth segments* present, bristles (6–)7–8, flattened, long plumose, 5–6 mm long, *c*. 3 times as long as the nutlet. *Stamens* 3; anther connective 4–6 mm long, white, drying dark purple, subulate; anthers *c*. 3 mm long, linear-oblong, base auriculate, with a scabrous apical appendage up to 0.8 mm long. *Style* 3-fid, base 5–6 mm long, glabrous, thin throughout, branches 5–7 mm long, hispidulous. *Nutlet* sessile, subovoid, subterete but somewhat trigonous, with 3 longitudinal ribs, maturing dark brown, apex brown, smooth, 1.5–1.7 mm long including the style base, *c*. 1 mm diam., mesocarp smooth, epidermal cells square–hexagonal, but inconspicuous; style base only slightly thickened, persistent, hispidulous, *c*. 0.3 mm long; embryo not examined. Photosynthetic pathway not examined.

Diagnostic characters: Distinctive in having culms with 5–10 nodes below the inflorescence; caudex present; inflorescence 10–35 cm wide, branches arcuate; rachilla curved around nutlet; and perianth segments (6)7 or 8, 5–6 mm long.

Distribution: A single species endemic to the Seychelles.

Etymology: From *xyron* (razor), referring to the razor sharp leaf lamina edges and the vernacular name (*Lerb razwar*) (Larridon *et al*. 2018a).

Xyroschoenus hornei (C.B.Clarke) Larridon, *Mol. Phyl. Evol.* 127: 207 (2018).

Basionym: *Schoenus hornei* C.B.Clarke in T.A.Durand & H.Schinz, *Consp. Fl. Afric.* 5: 657 (1894), *nom. cons. prop.; Lophoschoenus hornei* (C.B.Clarke) Stapf in Gibbs, *J. Linn. Soc. Bot.* 42: 181 (1914), *p.p*., excl. *Wright*.;

Costularia hornei (C.B.Clarke) Kük., *Repert. Spec. Nov. Regni Veg.* 44: 189 (1938); *Tetraria hornei* (C.B.Clarke) T.Koyama, *J. Fac. Sci. Univ. Tokyo, Sect. 3, Bot*. 8: 75 (1961).

Type: Seychelles: on mountains, Mahé Island, 1874, *J. Horne 626* (lecto: K 000244890*), *typ. cons. prop.* by Larridon *et al. Taxon* 65(5): 1225 (2017), recommended in Applequist, *Taxon* 69(2): 393 (2020); (isolecto: K 000244891*).

Costularia hornei var. *rectirhachilloidea* Kük., *Repert. Spec. Nov. Regni Veg.* 46: 28 (1939).

Type: Seychelles: Mahé Island, Cascade Estate, Feb. 1903, *Thomasset 171* (lecto designated by Henriette *et al. Phytotaxa* 231(1): 33 (2015): K).

Residual syntype: Seychelles: Praslin Island, Mar. 1899, *W. Schimper 136* (syn: B, *n.v.*).

[*Asterochaete elongata auct. non* Kunth: Baker, *Fl. Mauritius* 417 (1877).]

[*Schoenus xipholepis* (Baker) Summerh., *Bull. Misc. Inform. Kew* 1928: 394 (1928:). *p.p*. as to *Horne 626* only.]

Illustrations: Line drawing on sheet of *Horne 626* (K 000244890); Clarke (1909, t. 79, figs 5–7); Wise (1998, pl. 55); Porembski and Barthlott (2000, fig. 8.3); Larridon *et al.* (2018, fig. 1c); www.seychellesplantgallery.com/Native.html.

Description: As for the genus. (Figure 31).

Diagnostic characters: As for the genus.

Distribution: Endemic to the Seychelles where it is known from Curieuse, Félicité, Mahé (Bernica, Congo Rouge, Copolia, Glacis Sarcellas, Pérard, Sixpenny Hill, Trois Frères), Praslin (Midlands, Vallée de Mai) and Silhouette (Dans Giroffe, Mont Pot à Eau, Morne Blanc) Islands.

Habitat: Grows on the open fringes of granite outcrops where it can be dominant, in tropical dry forests and tropical moist lowland forests, and in areas of disturbance, in shallow sands and deep, heavy clay soils, from full sun to deep shade, from near sea level to mountain summits (see Wise 1998 for more details). Recorded in association with *Aphloia theiformis*, *Begonia sechellensis*, *Canthium bibracteatum*, *Costularia xipholepis*, *Curculigo seychellensis*, *Cyathea sechellarum*, *Cymbopogon citratus, Cynanchum viminale*, *Deckenia nobilis*, *Dianella ensifolia*, *Dicranopteris linearis*, *Dillenia ferruginea*, *Diospyros seychellarum*, *Dracaena angustifolia*, *Erythroxylum sechellarum*, *Euphorbia pyrifolia*, *Garnottia sechellensis*, *Gastonia crassa*, *Glionnetia sericea*, *Hypoxidia rhizophylla*, *Ixora pudica*, *Lycopodiella cernuua*, *Lodoicea maldivica*, *Malaxis seychellarum*, *Mapania floribunda*, *Medusagyne oppositifolia*, *Memecylon eleagni*, *Mimusops sechellarum*, *Nepenthes pervillei*, *Northea seychellana*, *Pandanus multispicatus*, *Pandanus sechellarum*, *Procris insularis*, *Protarum sechellarum*, *Seychellaria thomasetti*, *Soulamea terminalioides*, *Syzygium wrightii*, *Vanilla phalaenopsis* and *Verschaffeltia splendida*.

Phenology: Flowers recorded for January–May. Fruit recorded for August–September.

Specimens examined: SEYCHELLES: Praslin Island, [rec. 9 June 1892], *R. Alluaud s.n.* (P*); Mahé Island, Glacis Soncelles, Aug. 1982, *F. Friedman 3365* (P*); Mahé Island, Mont Blanc, May 1987, *F. Friedman 5112* (P*); Praslin Island, Midlands, Aug. 1985, *F. Friedman 5366* (P*); Praslin Island, Vallée de Mai, 24 June 1974, *G. Gusset & B. Jeune 219* (P*); Curieuse Island, 27 June 1974, *G. Gusset & B. Jeune 290* (P*); Mahé Island, 100 m alt., *J. Proctor 4468* (K, P*, WAG*); Mahé Island, Bernica Hill, 20 Jan. 1978, *S.A. Robertson 2521* (P*, WAG*); Mahé Island, Copolia, 14 Aug. 2014, *B. Senterre & E. Henriette 7107* (SEY*, P*, GENT, *n.v.*); Silhouette Island, Mont Pot à Eau, 18 Mar. 2008, *B. Senterre & J. Gerlach 5294* (SEY*, P*, GENT, *n.v.*); Silhouette Island, Mont Pot à Eau, 24 Sept. 2014, *B. Senterre & C. Morel 7108* (SEY*, P*, GENT, *n.v.*).

Conservation: While the area of occupancy is small (50 km^2), as this species occurs on several islands, grows in a range of habitats, and no immediate threats are known, it is listed as IUCN: Least Concern (Gerlach 2011). It occurs in Morne Seychellois National Park.

Etymology: The epithet honours the collector of the type specimen, John Horne (1835–1905), former director of the Pamplemousses Botanical Garden, Mauritius.

Common names: Known locally as Herbe rasoir, Lerb razwar, or l'herbe rasoir (razor herb), due to the very sharp, scabrous leaf margins.

Notes: Until recently, this species has been confused with *Costularia xipholepis*, which is not closely related. Henriette *et al.* (2015) clarified the taxonomy and historical confusion of names. As first noted by Summerhayes (1928) and discussed in detail by Larridon *et al.* (2017b), the name *Schoenus hornei* C.B.Clarke was not legitimately published since *Cladium xipholepis* Baker (1877) was included as a synonym. Larridon *et al.* (2017b) proposed conserving the name *Schoenus hornei* with a conserved type to maintain established usage. This has now been recommended (Applequist 2020) but has not yet been accepted.

Fig. 31. *Xyroschoenus hornei*, Seychelles, Mahé and Silhouette Islands. A. Habitat. B. Habit. C. Plant base. D. Leaf rosette. E. Cross-section of new leaves showing spirodistichous arrangement. F. Inflorescence. G. Inflorescence branchlets and flowering spikelets. H. Staminate spikelets. I. Elongate rachilla with fruit fallen. J. Elongate rachilla with slightly immature fruit. Photos A, E–J; by B. Senterre; B; by G. Gendron; C, D; by C. Morel; from www.seychellesplantgallery.com.

Readily distinguished from *Costularia xipholepis* (Baker) Henriette & Senterre, with which it can co-occur, by tristichous (*vs* distichous) leaves, with a well-defined midrib, elongate inflorescence with pendant branches (*vs* short with erect branches) and elongate, sinuous rachilla (*vs* short and straight).

Kükenthal (1939a: 28) gives a date of April 1875 for the collection of *G.* [sic] *Horne 626*, but this is more likely to be the date of receipt of the specimen examined, which may have been at B, but if so it has probably been destroyed.

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Appendix 1. Comparison of morphological features of genera and species in the *Tricostularia* clade. ? = attribute not known; C3 and C4 refer to photosynthetic pathway (see Bruhl & Wilson 2007).

Character	Plant											
Name	annual / perennial	tufted / open (rhizome elongate)	height (m)	rhizome thick / thin	rhizome diam. (mm)	pseudobulbous: Y/N/slightly	roots sand-binding: Y/N	clonal: Y/N	caudex: P/A	sheaths covering caudex: Y/N	sheath base fibrous: Y/N	sheath base colour
Ammothryon grandiflorum	perennial	tufted-open	0.7-1.5	thick	10-22	yes	yes	yes	present	yes	no	pale to reddish brown
Chaetospora	perennial	tufted	0.13-0.55	thin	0.8-3.4	yes	yes or no	yes	absent	yes	yes	reddish brown or straw coloured
Chaetospora curvifolia	perennial	tufted	0.13-0.5	thin	0.8-3.0	yes	yes	yes	absent	yes	yes	reddish brown
Chaetospora subbulbosa	perennial	tufted	0.15-0.55	thin	2-5	yes	no	yes	absent	yes	yes	reddish brown
Chaetospora turbinata	perennial	tufted	0.14-0.40	thin	1.2-3.4	yes	no	yes	absent	yes	yes	straw-coloured
Morelotia	perennial	tufted	0.2-1.2	thick	5-15	yes or no	yes or no	yes	absent	yes	yes or no	cream to pale to dark brown
Morelotia affinis	perennial	tufted	0.2-0.7	thick	5-10	slightly	no	yes	absent	yes	yes	cream to pale brown
Morelotia australiensis	perennial	tufted	0.3-1.3	thick	8-15	slightly	yes	yes	absent	yes	no	dark brown to blackish brown
Morelotia gahniiformis	perennial	tufted	0.2-0.7	thick	5-8	slightly	no	yes	absent	yes	yes	pale brown
Morelotia involuta	perennial	tufted	0.2-0.6	thick	10-15	no	no	yes	absent	yes	yes	pale to dark brown
Morelotia microcarpa	perennial	tufted	0.2-0.4(-0.6)	thick	6-8	yes	yes	yes	absent	yes	yes	pale brown
Morelotia octandra	perennial	tufted	0.7-1.2	thick	10-15	yes	yes	yes	absent	yes	yes	dark brown to blackish brown
Tetraria	perennial	tufted-open	0.3-3.0	thick or thin	1-45	no	yes	yes	absent or present	yes	yes (at least partial)	green to pale brown to dark brown
Tetraria arundinacea	perennial	tufted-open	1.5-3.0	thick	15-20	no	yes	yes	present	yes	yes	reddish brown to dark brown
Tetraria capillacea	perennial	tufted	0.3-0.6	thick	5-15	no	yes	yes	absent	yes	yes	chestnut-brown
Tetraria cernuua	perennial	tufted	0.3-0.7	thin	1-2	no	yes	yes	absent	yes	yes (margins only)	green to pale brown to dark brown
Tetraria thermalis	perennial	open-tufted	0.9-2.5	thick	20-45	slightly	yes	yes	present	yes	yes (at base only)	dark brown to blackish brown

(*Continued...*)

Character	**Plant**											
Name	annual / perennial	tufted / open (rhizome elongate)	height (m)	rhizome thick / thin	rhizome diam. (mm)	pseudobulbous: Y/N/slightly	roots sand-binding: Y/N	clonal: Y/N	caudex: P/A	sheaths covering caudex: Y/N	sheath base fibrous: Y/N	sheath base colour
Tricostularia	perennial	tufted	0.1-1.0(-1.3)	thin	0.7-2.1	no	yes	yes	absent	yes	yes or no	straw-coloured or pale to reddish brown
Tricostularia aphylla	perennial	tufted	0.3-0.6	thin	1.6-2.1	no	yes	yes	absent	yes	sometimes	pale brown
Tricostularia bennettiana	perennial	tufted	0.15-0.3	thin	1-1.5	no	yes	yes	absent	yes	no	pale brown
Tricostularia compressa	perennial	tufted	(0.15-)0.3-0.45	thin	0.7-1.2	no	yes	yes	absent	yes	no	pale brown
Tricostularia davisii	perennial	tufted	0.1-0.6	thin	8.8-1.2	no	yes	yes	absent	yes	no	pale brown
Tricostularia drummondii	perennial	tufted	0.5-0.8	thin	?	no	yes	yes	absent	yes	no	pale brown
Tricostularia exsul	perennial	tufted	0.4-1.0(-1.3)	thin	1.6-2.3	no	yes	yes	absent	yes	yes	pale brown
Tricostularia lepschii	perennial	tufted-open	0.15-0.4	thin	1-2.6	no	yes	yes	absent	yes	yes or no	pale brown
Tricostularia neesii	perennial	tufted	0.5-0.8	thin	0.9-1.6	no	yes	yes	absent	yes	no	pale to reddish brown
Tricostularia newbeyi	perennial	tufted	0.2-0.9	thin	1.5-2.5	no	yes	yes	absent	yes	no	pale brown
Tricostularia pauciflora	perennial	tufted	0.1-0.45(-70)	thin	1-2	no	yes	yes	absent	yes	no	pale to reddish brown
Tricostularia sandifordiana	perennial	open	0.3-0.9	thin	0.8-1.8	no	yes	yes	absent	yes	yes	straw-coloured or pale brown
Tricostularia sp. Albany	perennial	tufted	(0.4-)0.5-1	thin	?	no	yes	yes	absent	yes	?	?
Tricostularia sp. Mogumber	perennial	tufted	c. 0.4	thin	?	no	yes	yes	absent	yes	no	straw-coloured or pale brown
Tricostularia sp. Porongurup	perennial	tufted	c. 0.3	thin	?	no	yes	yes	absent	yes	?	?
Tricostularia sp. Two Peoples Bay	perennial	tufted	0.5-1	thin	?	no	yes	yes	absent	yes	no	pale to reddish brown
Xyroshoenus hornei	perennial	tufted	0.9-1.5(-2.0)	thick	20-50	no	no	yes	present	yes	sometimes	reddish to dark brown

(*Continued...*)

Character	**Culm**								
Name	slender / stout	erect / spreading	culms helicoid (spiralled)	no. nodes	culms angular / compressed (flattened) / terete to oval	culm diam. / width (mm)	culm height below inflorescence (cm)	culms ribbed / finely striate / smooth	culms glabrous / scabrous / other
Ammothryon grandiflorum	stout	erect	no	4-7	trigonous	2.5–7	55-80	finely striate	scabrous
Chaetospora	thin	erect	no	0	terete to compressed	0.6-2.5	11-53	finely striate, sometimes grooved	glabrous
Chaetospora curvifolia	thin	erect	no	0	terete to compressed	0.4-1.6	11-48	finely striate	glabrous
Chaetospora subbulbosa	thin	erect	no	0	terete to compressed	1.0-2.5	14-53	finely striate	glabrous
Chaetospora turbinata	thin	erect	no	0	terete to compressed	0.6-1.7	12-38	striate, sometimes grooved	glabrous
Morelotia	stout	erect	no	0, 1 or 3-4	trigonous or terete	1.0-5.5	6-100	striate to grooved	glabrous or rugulose
Morelotia affinis	stout	erect	no	0-2(-4)	trigonous	1.9-3.5	15-40	finely striate	glabrous
Morelotia australiensis	stout	erect	no	3-4	terete	2.0-5.5	15-100	striate	glabrous
Morelotia gahniiformis	stout	erect	no	1-3	trigonous	1.5-3.8	10-35	finely striate	glabrous
Morelotia involuta	stout	erect	no	1	trigonous	1.3-1.7	10-30	finely striate	glabrous
Morelotia microcarpa	stout	erect	no	1	trigonous	1.1-1.3	6-15(-25)	striate to grooved	rugulose-asperulous
Morelotia octandra	stout	erect	no	0 or 1	terete to trigonous at apex	1.0-3.5	55-85	striate	glabrous
Tetraria	stout or thin	erect to spreading	no	0-5	trigonous or terete	0.5-8	4-230	smooth or finely striate	glabrous
Tetraria arundinacea	stout	erect	no	3-4	trigonous	3-7	130-230	smooth but deeply grooved	glabrous
Tetraria capillacea	thin	erect	no	1-3	terete	1.5-3.1	30-60	finely striate	glabrous
Tetraria cernuua	thin	erect to spreading	no	0-1	terete	0.5-0.9	4-20	finely striate	glabrous
Tetraria thermalis	stout	erect	no	2-5	trigonous	4-8	50-120	smooth	glabrous

(*Continued...*)

Character	**Culm**								
Name	slender / stout	erect / spreading	culms helicoid (spiralled)	no. nodes	culms angular / compressed (flattened) / terete to oval	culm diam. / width (mm)	culm height below inflorescence (cm)	culms ribbed / finely striate / smooth	culms glabrous / scabrous / other
Tricostularia	stout or thin	erect to spreading	yes or no	0-5	compressed to terete	0.3-3.3	9-78	smooth or finely striate	glabrous
Tricostularia aphylla	stout	spreading (rarely erect)	yes	1-2(-3)	compressed	1.9-3.2	25-50	striate	glabrous
Tricostularia bennettiana	thin	erect	no	1(?-2)	terete	0.6-1.1	13-27	finely striate	glabrous
Tricostularia compressa	thin	erect	no	0	terete	0.4-0.6	28-42	smooth	glabrous
Tricostularia davisii	thin	erect	no	2	terete	0.3-0.8	9-58	finely striate	glabrous
Tricostularia drummondii	thin	erect	no	1-2	terete	0.7-1.0	45-75	finely striate	glabrous
Tricostularia exsul	thin	erect to spreading	no	2	terete	1.1-2.0	35-90(-120)	finely striate	glabrous
Tricostularia lepschii	thin	erect	no	0	terete	0.6-0.8	14-39	finely striate	glabrous
Tricostularia neesii	thin	erect	no	1-2	terete	0.5-1.5	48-78	finely striate	glabrous
Tricostularia newbeyi	thin	erect	no	1(-2)	terete	0.5-1.2	18-83	finely striate	glabrous
Tricostularia pauciflora	thin	erect to arcuate	no	0-2	terete	0.5-1.2	9-43(-68)	smooth	glabrous
Tricostularia sandifordiana	thin	erect	no	2-5	terete	0.7-1.7	26-87	finely striate	glabrous
Tricostularia sp. Albany	thin	erect	no	1(?+)	terete	0.6-1.2	(35-)45-100	finely striate	glabrous
Tricostularia sp. Mogumber	thin	erect to spreading	no	0	terete	?	c. 40	finely striate	glabrous
Tricostularia sp. Porongurup	thin	spreading	yes, slightly twisting	1(?+)	strongly compressed, almost flattened	1.2-1.9	c. 30	finely striate	glabrous
Tricostularia sp. Two Peoples Bay	thin	erect	no	1	terete	0.4-0.9	c. 50-95	finely striate	glabrous
Xyroshoenus hornei	stout	erect	no	5-10	trigonous	3-9	0.45-1.0(-1.4)	smooth	glabrous

(*Continued...*)

Character	**Leaves**			**Leaf sheath**						
Name	basal / cauline / both	bract- / leaf-like at base	spirotristichous / spirodistichous	body glabrous / scabrous / other	loose / clasping	length (mm)	broader than blade: Y/N	margin below blade hairy: Y/N	ligule: P/A	pseudopetiole: P/A
Ammothryon grandiflorum	both	leaf-like	spirotristichous	scabrous	loose	20–28(–38)	no	yes	absent	obscure or absent
Chaetospora	basal	leaf-like	spirodistichous	glabrous or scabrous	clasping	20-70	yes	yes	absent	obscure or absent
Chaetospora curvifolia	basal	leaf-like	spirodistichous	glabrous	clasping	20-40	yes	yes	absent	obscure or absent
Chaetospora subbulbosa	basal	leaf-like	spirodistichous	scabrous	clasping	20-40	yes	yes	absent	obscure or absent
Chaetospora turbinata	basal	leaf-like	spirodistichous	scabrous	clasping	40-70	yes	yes	absent	obscure or absent
Morelotia	both	leaf-like	spirodistichous	glabrous	loose or clasping	8-60	yes or equal	yes or no	absent	present, obscure or absent
Morelotia affinis	both	leaf-like	spirodistichous	glabrous	loose	35-60	yes	yes	absent	obscure or absent
Morelotia australiensis	both	leaf-like	spirodistichous	pubescent, glabrescent	clasping	20-45	equal	no	absent	obscure or absent
Morelotia gahniiformis	both	leaf-like	spirodistichous	glabrous	loose	25-39	yes	yes	absent	obscure or absent
Morelotia involuta	both	leaf-like	spirodistichous	glabrous	loose	26-38	yes	no	absent	obscure or absent
Morelotia microcarpa	both	leaf-like	spirodistichous	glabrous	clasping	8-30	equal	yes	absent	present
Morelotia octandra	both	leaf-like	spirodistichous	glabrous	clasping	18-35	equal	yes	absent	obscure or absent
Tetraria	basal or both	leaf-like	spirodistichous	glabrous	loose to clasping	18-82(-92)	yes or no	yes or no	absent	obscure or absent
Tetraria arundinacea	both	leaf-like	spirodistichous	glabrous	clasping	45-65	no	yes	absent	obscure or absent
Tetraria capillacea	both	leaf-like	spirodistichous	glabrous	clasping	18-82	yes	no	absent	obscure or absent
Tetraria cernuua	basal or both	leaf-like	spirodistichous	glabrous	loose to clasping	25-60(-92)	equal	no	absent	obscure or absent
Tetraria thermalis	both	leaf-like	spirodistichous	glabrous	clasping	52-80	no	yes	absent	obscure or absent

(Continued...)

Character	**Leaves**			**Leaf sheath**						
Name	basal / cauline / both	bract- / leaf-like at base	spirotristichous / spirodistichous	body glabrous / scabrous / other	loose / clasping	length (mm)	broader than blade: Y/N	margin below blade hairy: Y/N	ligule: P/A	pseudopetiole: P/A
Tricostularia	basal or both	bract-like	spirodistichous	glabrous	clasping, rarely loose	9-100	yes	yes or no	absent	obscure, absent or obvious
Tricostularia aphylla	both	bract-like	spirodistichous	glabrous	clasping	16-31	yes	yes	absent	obscure or absent
Tricostularia bennettiana	both	bract-like	spirodistichous	glabrous	clasping	16-28	yes	yes	absent	obscure or absent
Tricostularia compressa	basal	bract-like	spirodistichous	glabrous	clasping	9-44	yes	no	absent	obscure or absent
Tricostularia davisii	both	bract-like	spirodistichous	glabrous	clasping	13-25	yes	yes	absent	obscure or absent
Tricostularia drummondii	both	bract-like	spirodistichous	glabrous	clasping	?	yes	?	absent	obscure or absent
Tricostularia exsul	both	bract-like	spirodistichous	glabrous	clasping	33-80	yes	yes	absent	obscure or absent
Tricostularia lepschii	basal	bract-like	spirodistichous	glabrous	clasping	14-59	yes	no	absent	obscure or obvious
Tricostularia neesii	both	bract-like	spirodistichous	glabrous	clasping	12-100	yes	yes	absent	obscure or absent
Tricostularia newbeyi	both	bract-like	spirodistichous	glabrous	clasping	15-25	yes	yes (or no)	absent	obscure or absent
Tricostularia pauciflora	both	bract-like	spirodistichous	glabrous	clasping	11-17	yes	no	absent	obscure or absent
Tricostularia sandifordiana	both	bract-like	spirodistichous	glabrous	loose	9-21	yes	no	absent	obscure or absent
Tricostularia sp. Albany	both	bract-like	spirodistichous	glabrous	clasping	?	yes	?	absent	obscure or absent
Tricostularia sp. Mogumber	basal	bract-like	spirodistichous	glabrous	clasping	?	yes	?	absent	1-12.5
Tricostularia sp. Porongurup	both	bract-like	spirodistichous	glabrous	clasping	?	yes	?	absent	obscure or absent
Tricostularia sp. Two Peoples Bay	both	bract-like	spirodistichous	glabrous	clasping	?	yes	no	absent	obscure or absent
Xyroshoenus hornei	both	leaf-like	spirodistichous	scabrous	loose	30-60	yes	no	absent	obscure or absent

(*Continued…*)

Character	**Leaf blade**							
Name	lower leaf length (cm)	lower leaf width (mm)	linear / attenuate	section	margin entire / other	margin hairy: Y/N	midrib hairy: Y/N	apex shape
Ammothryon grandiflorum	(15–)22–46	5–15	linear	flat or folded	entire	yes	yes	attenuate
Chaetospora	4-21	0.3-0.9	linear	flat to canaliculate to involute and appearing terete	entire or serrulate	yes	no	long-attenuate
Chaetospora curvifolia	5–20	0.3-0.9	linear	flat to canaliculate	entire	yes	no	long-attenuate
Chaetospora subbulbosa	4-15	0.3-0.7	linear	flat to canaliculate, slighty involute`	entire	yes	no	long-attenuate
Chaetospora turbinata	6-21	0.3-0.7	linear	canaliculate to involute, appearing terete	serrulate	yes	no	long-attenuate
Morelotia	12-62	2-8	linear	flat, channeled or revolute	entire	yes	yes or no	long-attenuate
Morelotia affinis	20-62	4-8	linear	flat, involute and appearing terete with age	?serrulate	yes	yes	long-attenuate
Morelotia australiensis	12-18	2-6	linear	channelled to flat	entire	yes	yes	long-attenuate
Morelotia gahniiformis	15-45	2-8	linear	flat, involute and appearing terete with age	?serrulate	yes	no	long-attenuate
Morelotia involuta	20-60	2.5-4	linear	flat, involute and appearing terete with age	entire	yes	no	long-attenuate
Morelotia microcarpa	16-38(-60)	2-2.5	linear	flat or complicate, margins often recurved	entire	yes	no	long-attenuate
Morelotia octandra	15-60	2-4	linear	revolute	entire	yes	no	long-attenuate
Tetraria	6-100	0.5-24	linear	flat to involute and appearing terete, or V-shaped	denticulate or entire	yes	no	long-attenuate
Tetraria arundinacea	40-100	5-10	linear	V-shaped	denticulate	yes	no	long-attenuate
Tetraria capillacea	12-48(-75)	0.5-0.7	linear	V-shaped, margins flat to involute	entire	yes	no	setaceous

(*Continued...*)

Character	**Leaf blade**							
Name	lower leaf length (cm)	lower leaf width (mm)	linear / attenuate	section	margin entire / other	margin hairy: Y/N	midrib hairy: Y/N	apex shape
Tetraria cernuua	6-25	1.1-2.0	linear	flat to lunate, incurved and appearing terete with age	entire	yes	no	long-attenuate
Tetraria thermalis	17-40(-80)	10-24	linear	flat to broadly V-shaped	entire	yes	no	long-attenuate
Tricostularia	0-12.5	0.1-1.1	linear or triangular	flat to channelled	entire	yes or no	no	long-attenuate or acute
Tricostularia aphylla	0.6-1.5(-2.4)	0.7-1.1	linear	flat to channelled	entire	yes	no	long-attenuate
Tricostularia bennettiana	0.1-0.3	0.05	linear	flat	entire	yes	no	long-attenuate
Tricostularia compressa	0-0.1	0.3	triangular	flat	entire	no	no	acute
Tricostularia davisii	0.3-1.0	0.1-0.3	linear	flat	entire	yes	yes	long-attenuate, setaceous
Tricostularia drummondii	1-5(-8)	?	linear	flat	entire	?	?	long-attenuate
Tricostularia exsul	0.1-0.2	0.4-0.6	linear	flat	entire	yes	no	acute
Tricostularia lepschii	0.25-0.35	0.25-0.35	linear	flat	entire	yes	no	long-attenuate to acute
Tricostularia neesii	0.3-0.5	0.2-0.4	linear	flat	entire	yes or no	no	attenuate
Tricostularia newbeyi	0.1-0.2	0.05	triangular	flat	entire	yes	no	acute
Tricostularia pauciflora	0.5-6(-7)	0.3-0.7	linear	channelled	entire	no	no	long-attenuate
Tricostularia sandifordiana	0.6-1.1	0.6-0.9	linear	channelled	entire	yes	no	long-attenuate
Tricostularia sp. Albany	1-3	?	linear	flat	entire	?	?	?
Tricostularia sp. Mogumber	c. 0.3-0.5	?	linear	flat	entire	?	?	?
Tricostularia sp. Porongurup	1-12.5	?	linear	?	entire	?	?	?
Tricostularia sp. Two Peoples Bay	c. 0.3-0.5	?	linear	flat	entire	?	?	?
Xyroshoenus hornei	50-90	(5-)10-15	linear	flat, revolute with age	denticulate	yes	yes	long-attenuate

(Continued...)

Character	**Inflorescence**													
Name	form	shape in outline	length (cm)	width / diam. (mm)	Length ratio relative to diam. (min to max)	no. nodes	bracts: bract- / leaf-like	bracts > / = / < branchlets (can = spikelet clusters)	branches spreading / other	basal lateral branch length (mm)	spikelet no./ lateral branchlet	peduncle length below spikelet (mm)	spikelet prophyll: P/A	spikelet prophyll length
Ammothryon grandiflorum	open panicle-like	narrow	12–75	20–45	6-17	8-15	leaf-like	exceeding	spreading	45-75	(1–)3–12	7–16	absent	n/a
Chaetospora	head-like or elongate head-like	subglobular, obovate or turbinate	0.5-1.7	6-16	0.8-1.1	2-6	leaf-like	exceeding	compact, hidden	4.5-6.6	(1)2-5	0.1-1.4	present	1.1-3.8
Chaetospora curvifolia	head-like	subglobular	0.5-1.2	7-15	0.7-0.8	2-6	leaf-like	exceeding	compact, hidden	4.5-6.1	3-5	0.1-0.5	present	3.8
Chaetospora subbulbosa	head-like	subglobular	0.6-1.3	9-16	0.7-0.8	3-6	leaf-like	exceeding	compact, hidden	5.1-6.6	3-5	0.2-1.4	present	1.1
Chaetospora turbinata	elongate head	obovate to turbinate	0.6-1.7	6-10	1-1.7	2-4	leaf-like	exceeding	compact, hidden	5.9-6.3	2-4	0.4-0.8	present	3.1
Morelotia	open or dense panicle-like	linear to lanceolate	5-35	5-35	3.3-21(-25)	3-8	leaf-like	shorter to exceeding	erect	20-70	2-20	0.5-5	present	1.4-13
Morelotia affinis	dense panicle-like	linear	5-30	15-35	3.3-8.5	5-8	leaf-like	exceeding	erect	20-70	3-15	0.5-1	present	1.4-1.6
Morelotia australiensis	open panicle-like	linear	15-27	10-20	15-13.5	3-5	leaf-like	shorter to equal	erect	30-45	3-10	1-2	present	3.7-4.1
Morelotia gahniiformis	dense panicle-like	linear	(5-)10-35	10-25	(5-)10-14	3-7	leaf-like	exceeding	erect	35-65	2-8	0.5-2	present	2.1-2.5
Morelotia involuta	dense panicle-like	linear	10.5-21	5-10	c. 21	5-8	leaf-like	exceeding	erect	20-25	(1)2 or 3	0.5-3	present	5.3-6.3
Morelotia microcarpa	subspiciform panicle-like	linear	6-15(-25)	7-10	8.5-15(-25)	5-7	leaf-like	exceeding	erect	8-40	12-20	0.5-3	present	3.3-3.8
Morelotia octandra	open panicle-like	linear to lanceolate	13-35	10-20	13-17.5	4-7	leaf-like	equal to exceeding	erect	25-45	10-16	0.5-5	present	5.3-13
Tetraria	elongate panicle-like	linear to lanceolate	6-80	1.5-100	0.7-17	1-11	leaf-like at base and bract-like above	shorter to exceeding	erect, spreading, or arcuate	2.5-200	1-6	0.5-15	present	1.3-23.5
Tetraria arundinacea	elongate panicle-like	lanceolate	30-70	50-100	6-0.7	6-11	leaf-like at base and bract-like above	shorter	erect to spreading	70-200	2-6	0.5-4.5	present	1.3-2.6
Tetraria capillacea	elongate panicle-like	linear	6-25	8-15	7.5-17	4-7(-10)	leaf-like at base and bract-like above	exceeding	erect	46-85	3-5	0.5-15	present	3.6-4.4
Tetraria cernuua	elongate panicle-like	linear	6-28	15-80	4-3.5	1-4	leaf-like at base and bract-like above	equal to exceeding	arcuate	25-40	1-2	0-2.5	present	2.4-3.3
Tetraria thermalis	elongate or contracted panicle-like	lanceolate	17-80	25-50	7-16	(5-)6-10	leaf-like	equal to exceeding	erect	35-70	2-6	1-3.5	present	19-23.5
Tricostularia	slender or contracted panicle-like or subcapitate	linear, to oblate	0.7-12	3-17	1.7-20	0-9	bract-like, rarely almost pungent	shorter to exceeding	erect	0-29	1-7	0.2-4	present	0.6-10.6

(*Continued...*)

Character	Inflorescence													
Name	form	shape in outline	length (cm)	width / diam. (mm)	Length ratio relative to diam. (min to max)	no. nodes	bracts: bract- / leaf-like	bracts > / = / < branchlets (can = spikelet clusters)	branches spreading / other	basal lateral branch length (mm)	spikelet no./ lateral branchlet	peduncle length below spikelet (mm)	spikelet prophyll: P/A	spikelet prophyll length
Tricostularia aphylla	slender panicle-like	linear	4.5-9	3-9	15-10	4-9	bract-like	shorter	erect	10-26	(2-)3-7	1.5-4	present	3.9-5.5
Tricostularia bennettiana	contracted panicle-like	linear	1.5-3.5	5-8	3-4.4	2-4	bract-like	exceeding	erect	5-7	1-3	0.5-1	present	5-6.5
Tricostularia compressa	contracted panicle-like	narrow-oblate	1.5-3.2	4-7	3.7-5	2-4	bract-like	shorter	erect	5-9	3-5	1	present	1.7-2.4
Tricostularia davisii	contracted panicle-like (subcapitate)	obconical to obovate	0.7-1.5	3-5	2.3-4.4	3-5	bract-like, sometimes almost pungent	exceeding	erect	5-11	1-2	0.2-0.8	present	0.6-0.9
Tricostularia drummondii	slender panicle-like	linear m/less	3-4(-7)	c. 3-5	c. 4	5-6	bract-like	exceeding	erect	c. 15	2-3	?	present	?
Tricostularia exsul	elongate panicle-like-like	linear	8-12	4-9	20-13.3	5-9	bract-like	equal	erect	20-29	3-7	1-3	present	9.5-13
Tricostularia lepschii	contracted panicle-like	subglobular to ovate	0.7-1.1	4-8	1.7-1.4	1-2(-3)	bract-like	shorter to equal	erect	4-6	2-4	0.5-1	present	4-4.8
Tricostularia neesii	contracted panicle-like	narrow-oblate to lanceolate	1.5-2.2	4-6	3.7-4	2-4	bract-like	exceeding	erect	10-15	1-2	0.1-0.5	present	4.0-6.1
Tricostularia newbeyi	slender panicle-like	linear	1.5-6	5-8	3-7.5	6-9	bract-like	shorter	erect	7-12	(1-)2-4	0.5-1.5	present	3.7-5
Tricostularia pauciflora	contracted panicle-like	oblate	0.8-1.5	5-8	1.6-1.9	0 or 1	bract-like	shorter	erect	n/a	1-3	1-3	present	3.6-5.5
Tricostularia sandifordiana	contracted panicle-like	oblate to lanceolate	1.7-4.5	10-17	1.7-2.6	0-1	bract-like	shorter	erect	8-12	2-5	1-3.5	present	7.6-10.6
Tricostularia sp. Albany	elongate panicle-like-like	linear, with disjunct, sterile lowest node	4-8	2-3	2-2.7	5-6	bract-like	exceeding to equalling	erect	?	?	?	present	?
Tricostularia sp. Mogumber	sub-capitate	obconical / obovate in outline	c. 1	?	<2	?0-1	bract-like	shorter	erect	?	?	?	present	?
Tricostularia sp. Porongurup	slender panicle-like	linear	c. 8-15	c. 5	16-40	c. 8-12	bract-like	shorter	erect	?	?	?	present	?
Tricostularia sp. Two Peoples Bay	elongate panicle-like-like	linear	(6-)8-12	c. 2	(3-)4-6	5-7	bract-like	shorter or equal	erect	?	?	?	present	?
Xyroshoenus hornei	open panicle-like	lanceolate to ovate	45-60	100-350	4.5-1.7	8-12	leaf-like	shorter	arcuate	80-250	1	3-8	present	1.5-2.2

(*Continued...*)

Character	**Spikelets**											
Name	glume colour	shape in outline	length (mm)	width (mm)	no. glumes	no. fertile	upper flower fertility	2nd flower fertility	3rd flower fertility	4th flower fertility	basal glume length	fertile glume indumentum
Ammothryon grandiflorum	brown	narrow-ovate	12–22	2.2-2.6	10–14	2–4	bisexual fertile	bisexual fertile	bisexual fertile	bisexual fertile	3-6	hairy, glabrescent
Chaetospora	pale to dark brown or chestnut	narrow-ovate	4.7-8	1.2-3.2	5-9	1-3	bisexual fertile	functionally male or sterile	functionally male or sterile	n/a	2.6-4.5	puberulent or glabrous
Chaetospora curvifolia	dark brown to black	narrow-ovate	4.7-6.9	1.9-2.7	5-8	1-2	bisexual fertile	functionally male or sterile	n/a	n/a	2.8	puberulent or glabrous
Chaetospora subbulbosa	pale brown	narrow-ovate	5-8	1.2-1.8	6-8	3	bisexual fertile	functionally male or sterile	functionally male or sterile	n/a	2.6	puberulent
Chaetospora turbinata	pale red-brown to chestnut brown	narrow-ovoid to oblong-ovoid or compressed	5.5-8.0	1.9-3.2	5-9	1	bisexual fertile	n/a	n/a	n/a	4.5	puberulent
Morelotia	pale to brown to dark brown or chestnut	lanceolate to ovate	6.5-15	0.9-3.1	5-8(-9)	1-2	bisexual fertile, infertile or male sterile	bisexual fertile or bisexual sterile or male fertile	bisexual fertile or absent	n/a	2.5-7.8	glabrous, scabrous or pubescent
Morelotia affinis	reddish brown	narrow-lanceolate to ovate-lanceolate	6.5-10	1.4-2.2	7	2	infertile	functionally male	bisexual fertile	n/a	2.8	puberulent
Morelotia australiensis	pale brown	narrow-ovate	8-10	1.8-2.3	5	2	bisexual fertile	bisexual sterile or ?male fertile	n/a	n/a	6-7	glabrous
Morelotia gahniiformis	brown	narrow-ovate	8-10	2-3	6-8	2	infertile	functionally male	bisexual fertile	n/a	3.8-4.1	hispidulous
Morelotia involuta	brown	lanceolate	7-9	1.3-1.5	7	1	infertile	bisexual fertile	n/a	n/a	4	glabrous
Morelotia microcarpa	dark brown	lanceolate	3.5-4	0.9-1.1	6	3	bisexual fertile	bisexual sterile	bisexual sterile	n/a	1.2-2.2	scabrous
Morelotia octandra	chestnut to brown	ovate	10-15	2-3.1	7(9)	2	male sterile	bisexual fertile	n/a	n/a	5.0-7.8	scabrous to pubescent
Tetraria	pale to dark brown	elliptic to ovate	4.7-25	1.1-3.6	5-9	2-3	bisexual fertile	bisexual fertile or functionally male	functionally male or absent	n/a	1.1-15	glabrous or puberulent, or margins scabrid
Tetraria arundinacea	brown	oblate to lanceolate	4.7-6.6	1.2-1.8	6-9	2	bisexual fertile	bisexual fertile	n/a	n/a	1.1-1.9	glabrous but margins ciliate
Tetraria capillacea	brown	elliptic to lanceolate	5.5-10.5	1.5-2	5-9	2(-3)	bisexual fertile	bisexual fertile or functionally male	functionally male or absent	n/a	2.2-2.8	glabrous but margins ciliate
Tetraria cernuua	pale brown to red-brown	elliptic	8-15	1.1-2.0	(8)9	2	bisexual fertile	funtionally male	n/a	n/a	2.8-3.1	glabrous
Tetraria thermalis	brown to dark brown	ovate	16-25	2.2-3.6	8-9	3	bisexual fertile	bisexual fertile or functionally male	functionally male	n/a	12-15	puberulous above, margins glabrous to ciliate

(*Continued...*)

Character	**Spikelets**											
Name	glume colour	shape in outline	length (mm)	width (mm)	no. glumes	no. fertile	upper flower fertility	2nd flower fertility	3rd flower fertility	4th flower fertility	basal glume length	fertile glume indumentum
Tricostularia	brown	lanceolate to oblate	2.8-11	0.9-3.4	4-7(-9)	2-3	bisexual fertile	male fertile	male fertile or absent	n/a	1.4-4.5	glabrous, margins and keel ciliate or scabrous
Tricostularia aphylla	brown	lanceolate	4.7-7.2	1.7-2.4	(5-)7	2 or 3	bisexual fertile	male fertile	male fertile or absent	n/a	2.7-3.1	glabrous (margin finely ciliate)
Tricostularia bennettiana	reddish brown	lanceolate	4-6	1.5-1.8	5-6	2	bisexual fertile	bisexual fertile	n/a	n/a	2.2-2.7	scabrous on keel and margins
Tricostularia compressa	brown	oblate	2.8-5.1	0.9-1.6	4-5	2	bisexual fertile	male fertile	n/a	n/a	1.4-2.3	glabrous
Tricostularia davisii	brown	lanceolate	3.7-5.1	0.9-1.1	6	2	bisexual fertile	male fertile	n/a	n/a	2.9-4.2	ciliate on keel and margins
Tricostularia drummondii	?	lanceolate	?	?	?	?2	bisexual fertile	?	?n/a	n/a	?	glabrous
Tricostularia exsul	brown	lanceolate	8.5-11	2.1-3.3	5-6	3	bisexual fertile	male fertile	male sterile	n/a	3.6-4.2	scabrous on keel and margins
Tricostularia lepschii	brown	lanceolate	4-6	1.2-1.3	6	2	bisexual fertile	bisexual fertile or functionally male	n/a	n/a	1.5-3	glabrous (keel scabrous)
Tricostularia neesii	brown	lanceolate	5.5-6.8	1.1-1.7	5-6	2	bisexual fertile	male fertile	n/a	n/a	3.6-4.5	ciliate on keel and margins
Tricostularia newbeyi	pale brown to brown	lanceolate	4.4-5.6	1.3-1.8	6-7	2	bisexual fertile	bisexual fertile or functionally male	n/a	n/a	2.9-3.4	glabrous (keel & marigins scabrous)
Tricostularia pauciflora	brown	lanceolate	4-6	1.7-3	5 or 6	2 or 3	bisexual fertile	male fertile	male fertile or absent	n/a	2.5-3.5	glabrous (keel scabrous)
Tricostularia sandifordiana	brown	lanceolate	8-10	1.4-2.0	7(+2)	2	bisexual fertile	male fertile	n/a	n/a	1.6-2.1	glabrous (keel & marigins scabrous)
Tricostularia sp. Albany	mid yellow-brown to mid red-brown near apex	lanceolate	?	?	?	?2	bisexual fertile	?	?n/a	n/a	?	?
Tricostularia sp. Mogumber	pale brown to brown	lanceolate	?	?	?	?2	bisexual fertile	?	?n/a	n/a	?	?
Tricostularia sp. Porongurup	dark brown	lanceolate	'large'	?	?	?2	bisexual fertile	?	?n/a	n/a	?	?
Tricostularia sp. Two Peoples Bay	mid yellow-red brown	lanceolate	?	?	?	?2	bisexual fertile	?	?n/a	n/a	?	glabrous
Xyroshoenus hornei	brown to dark brown	oblate to lanceolate	5-8	1.5-2	7-9	2	bisexual fertile	male fertile	n/a	n/a	2.5	hispidulous

(*Continued...*)

Character											
Name	fertile glume apex	fertile glume length (mm)	fertile glume width (mm)	mucro length (mm)	rachilla compact / elongate	rachilla sinuous: Y/N	perianth: P/A	# perianth segments	perianth length (mm)	perianth shape	perianth indumentum
Ammothryon grandiflorum	acute	11-20	2-2.4	3.9-4.5	compact	not or scarsely	absent	n/a	n/a	n/a	n/a
Chaetospora	acute to acuminate	3.8-6.0	0.9-1.6	0.3-1.5	compact	no	present	6	0.2-2.0	flat or compressed to bristle-like	margins glabrous, ciliate or plumaose
Chaetospora curvifolia	acute to acuminate	4.2-5.9	1.1-1.3	1.1-1.5	compact	no	present	6	1.5-2.0	flat	margins ciliate
Chaetospora subbulbosa	acute to acuminate	3.8-6.0	0.9-1.4	0.3-0.9	compact	no	present	6	0.2-0.4	compressed to terete	glabrous or margins ciliate
Chaetospora turbinata	acute to acuminate	4.5-6.0	1.1-1.6	0.6-1.2	compact	no	present	6	1.2-2.0	compressed to bristle-like	plumose
Morelotia	obtuse or acute to acuminate	4.5-11.5	1.6-3.4	0.4-3.0	compact or fruiting internode elongate	once or no	absent or present	0, 2 or 6	0.4-1.5	filiform	glabrous
Morelotia affinis	acuminate to acute	4.5-9.0	1.8-3.4	0.4	fruiting internode elongate and curved	once	absent	n/a	n/a	n/a	n/a
Morelotia australiensis	acute to obtuse	6-9	1.6-2.1	1.5	compact	no	absent	n/a	n/a	n/a	n/a
Morelotia gahniiformis	acuminate to acute	5.6-9.9	1.8-3.4	1.5	fruiting internode elongate and curved	once	absent	n/a	n/a	n/a	n/a
Morelotia involuta	acuminate	8-9	1.7-2.1	3.0	compact	no	present	6	0.4-1.1	filiform	glabrous
Morelotia microcarpa	acute to acuminate	2.6-3.4	0.7-0.9	3.0	compact	no	absent or present	2	1-1.5	compressed	glabrous
Morelotia octandra	acute to acuminate	7.2-11.5	1.8-2.9	0.5-1.0	compact	shortly around fruit	absent	n/a	n/a	n/a	n/a
Tetraria	acute to long-acuminate	4.1-15	0.8-3.5	0-12	compact	no	absent or present	0 or 6	0.4-5	filiform or subulate or absent	glabrous, scabrid or plumose
Tetraria arundinacea	subacute	4.1-5.3	1.1-1.7	0.5	compact	no	present	6	3.3-4.4	filiform	densely scabrous
Tetraria capillacea	acute	6.0-8.5	0.8-1.6	0.7	compact	no	absent or present	0 or 6	0.4-0.6	filiform	glabrous to minutely scrabrid, margins minutely ciliate
Tetraria cernuua	acute to acuminate	8.5-12	1.1-1.5	0	compact	no	?absent	n/a	n/a	n/a	n/a

(*Continued...*)

Character											
Name	fertile glume apex	fertile glume length (mm)	fertile glume width (mm)	mucro length (mm)	rachilla compact / elongate	rachilla sinuous: Y/N	perianth: P/A	# perianth segments	perianth length (mm)	perianth shape	perianth indumentum
Tetraria thermalis	long-acuminate	12-15	2.1-3.5	5-12	compact	no	present	6	3-5	subulate	plumose
Tricostularia	obtuse or acute to acuminate	2.9-9.8	0.7-2.8	0-1.2	compact	no	present	6	0.2-1.2	flattened to subulate	glabrous or margins ciliate
Tricostularia aphylla	acute	4.5-7.0	1.5-2.2	0	compact	no	present	6	0.8-1.0	flattened, narrowly triangular	margins ciliate
Tricostularia bennettiana	acuminate	3.7-4.9	1.3-1.6	0.7	compact	no	present	6	0.6-1	filiform	a few minute hairs at apex
Tricostularia compressa	obtuse to acute	3.3-4.1	0.8-1.1	0	compact	no	present	6	0.3-0.9	subulate	glabrous
Tricostularia davisii	acuminate	3.2-4.2	0.7-0.9	0.2-0.6	compact	no	present	6	0.4-0.6	subulate	glabrous or minutely hispid at apex
Tricostularia drummondii	acuminate	c. 3	?	0.2-0.3	compact	no	present	6	?	?	?
Tricostularia exsul	acuminate	7.0-8.8	1.3-2.2	0.3-1.0	compact	no	present	6	0.7-2.0	filiform	scabrous
Tricostularia lepschii	acute to acuminate	4-4.5	1-1.1	0.6	compact	no	present	6	0.4-1.1	compressed to filiform	a few minute hairs at apex
Tricostularia neesii	acuminate	4.7-5.8	0.9-1.3	0.6-1.2	compact	no	present	6	0.5-1.2	filiform	a few minute hairs at apex
Tricostularia newbeyi	acuminate	3.5-5	1.1-1.6	0.8	compact	no	present	6	0.5-1.1	filiform	a few minute hairs at apex
Tricostularia pauciflora	acute to acuminate	2.9-4.0	1.5-2.8	0.5	compact	no	present	6	0.2-0.8	flattened	glabrous
Tricostularia sandifordiana	acute	6.3-9.8	1.5-2.8	0-0.5	compact	no	present	6	0.6	flattened	glabrous
Tricostularia sp. Albany	acuminate	c. 5	?	c. 0.2	compact	no	?	?	?	?	glabrous
Tricostularia sp. Mogumber	acuminate?	?	?	?	compact	no	?	?	?	?	?
Tricostularia sp. Porongurup	acuminate?	?	?	?	compact	no	?	?	?	?	?
Tricostularia sp. Two Peoples Bay	acuminate	6-7	?	0.1-0.2	compact	no	?	?	?	?	sparsely minutely ciliolate; otherwise glabrous
Xyroshoenus hornei	cuspidate	5-6	1.8-2.6	0	elongate	sinuous around fruit	present	(6-)7-8)	5-6	flattened	long plumose

(*Continued...*)

Character	**Stamens**							
Name	no.	connective length (mm)	connective shape	connective persistent on nut: Y/N	anther colour	anther length (mm)	anther appendage length (mm)	anther appendage indumentum
Ammothryon grandiflorum	3	6–11	linear to subulate	no	pale yellow	7–10	1.0–1.5	glabrous
Chaetospora	3	2.0-6.2	linear to subulate	no	yellow	1.8-3.1	0.5-0.8	glabrous
Chaetospora curvifolia	3	2.6-4.5	linear to subulate	no	yellow	2.0-2.5	0.5-0.7	glabrous
Chaetospora subbulbosa	3	2.0-3.5	linear to subulate	no	yellow	2.3-3.1	0.6-0.8	glabrous
Chaetospora turbinata	3	4.4-6.2	linear to subulate	no	yellow	1.8.2.5	0.5-0.6	glabrous
Morelotia	3, 6 or 8	1.8-9.6	linear	yes or no	yellow or pale yellow	3.1-6.5	0.5-2.0	glabrous or scaberulous
Morelotia affinis	3	6.3-8.8	linear	yes	yellow	3.6-4.2	1.4	glabrous
Morelotia australiensis	(3)6	5-7	linear	no	yellow	5.5-6.5	1.0	scaberulous
Morelotia gahniiformis	3	4.3-9.6	linear	yes	yellow	3.1-4.2	0.5	scaberulous
Morelotia involuta	3	5.1-6.8	linear	yes	pale yellow	4-5	2.0	glabrous
Morelotia microcarpa	3	1.8-2.5	subulate	no	yellow	0.8-0.9	0.2	glabrous
Morelotia octandra	(4, 6)8(9)	5.3-8.4	linear	no	pale yellow	4.4-6.2	1.4	glabrous
Tetraria	3	3.4-16	subulate	no	yellow	2.3-3.8	0.4-1.1	glabrous or scaberulous
Tetraria arundinacea	3	3.4-3.9	subulate	no	yellow	2.3-2.7	0.4	glabrous
Tetraria capillacea	3	5.1-7.5	subulate	no	yellow	2.6-2.9	1.1	scaberulous
Tetraria cernuua	3	6.1-8.5	subulate	no	yellow	2.5	0.9	glabrous
Tetraria thermalis	3	12-16	subulate	no	yellow	3.4-3.8	0.7	glabrous
Tricostularia	3	2.3-6.9	subulate	no	yellow, pale yellow, cream	1.4-4.6	0.15-0.9	glabrous

(*Continued...*)

Character	**Stamens**							
Name	no.	connective length (mm)	connective shape	connective persistent on nut: Y/N	anther colour	anther length (mm)	anther appendage length (mm)	anther appendage indumentum
Tricostularia aphylla	3	5.1-6.9	subulate	no	pale yellow	2.0-4.0	0.2-0.5	glabrous
Tricostularia bennettiana	3	3.4-4.3	subulate	no	cream	2.6-3	0.5	glabrous
Tricostularia compressa	3	3.0-3.7	subulate	no	pale yellow	2.8-3.5	0.5	glabrous
Tricostularia davisii	3	3.3-4.6	subulate	no	cream	2.4-2.6	0.6-0.8	glabrous
Tricostularia drummondii	3	?	subulate	no	?	?	?	glabrous
Tricostularia exsul	3	5.9-7.8	subulate	no	yellow	3.6-4.1	0.8-1.2	glabrous
Tricostularia lepschii	3	unknown	subulate	no	unknown	1.5-2.2	0.3	glabrous
Tricostularia neesii	3	3.1-4.6	subulate	no	yellow	2.7-3.4	0.4-0.5	glabrous
Tricostularia newbeyi	3	4.1-5.5	subulate	no	yellow	2	0.3	glabrous
Tricostularia pauciflora	3	2.3-3.8	subulate	no	cream	1.4-1.6	0.15-0.2	glabrous
Tricostularia sandifordiana	3	3.1-3.6	subulate	no	yellow	4.2-4.6	0.9	glabrous
Tricostularia sp. Albany	?	?	?	?	?	c. 3	c. 0.5	glabrous
Tricostularia sp. Mogumber	?	?	?	?	?	?	?	?
Tricostularia sp. Porongurup	?	?	?	?	?	?	?	?
Tricostularia sp. Two Peoples Bay	?	?	?	?	?	?	?	?
Xyroshoenus hornei	3	4-6	subulate	no	yellow	3	0.8	scaberulous

(*Continued...*)

Character	Style						
Name	total length (mm)	base length (mm)	base enlarged: Y/N	base: glabrous / hairy	branch no.	branch length (mm)	branches: glabrous / hairy
Ammothryon grandiflorum	16–22	8–12	yes, slightly	glabrous	3	8–10	hairy
Chaetospora	3.5-5.6	1.4-3.5	no	glabrous	3	1.3-2.9	hairy
Chaetospora curvifolia	3.8-5.6	2.5-3.1	no	glabrous	3	1.3-2.5	hairy
Chaetospora subbulbosa	3.5-5.6	1.4-2.7	no	glabrous	3	2.1-2.9	hairy
Chaetospora turbinata	4.0-5.0	2.7-3.5	no	glabrous	3	1.3-1.5	hairy
Morelotia	7.0-15	3-7.3	yes or no	hairy or glabrous	3-5	2.5-10	hairy
Morelotia affinis	7.0-7.9	3.9-4.2	no	hairy	3	3.1-3.7	hairy
Morelotia australiensis	7.5-10	5-7	no	glabrous	3	2.5-3.0	hairy
Morelotia gahniiformis	7.1-8.0	4.6-5.1	no	hairy	3	2.5-2.9	hairy
Morelotia involuta	10-15	3-5	no	glabrous	3	7-10	hairy
Morelotia microcarpa	3.1-3.8	1.8-2.3	yes	glabrous	3	1.3-1.5	hairy
Morelotia octandra	8-10.5	5.5-7.3	yes	hairy	3-5	2.5-3.3	hairy
Tetraria	5.0-19	2.7-9	yes or no	hairy (at least partly)	3-4	1.6-10	hairy
Tetraria arundinacea	5.0-6.0	3.4-4.1	yes	hairy	3	1.6-1.9	hairy
Tetraria capillacea	6.7-8.1	4.8-5.6	no	hairy in upper half	3	1.9-2.5	hairy
Tetraria cernuua	6.6-7.4	2.7-3.1	no	hairy towards the apex	3	3.9-4.3	hairy
Tetraria thermalis	15.5-19	7.5-9	no	hairy	3-4	8-10	hairy
Tricostularia	2.0-6.4	0.5-3.5	no	hairy or glabrous	3	1.3-3.7	hairy
Tricostularia aphylla	4.6-6.4	1.9-2.7	no	glabrous	3	2.7-3.7	hairy
Tricostularia bennettiana	5.2-7.1	3.1-4.3	no	hairy towards the apical 1/3	3	2.1-2.8	hairy
Tricostularia compressa	2.7-3.6	1.4-1.7	no	glabrous	3	1.3-1.9	hairy
Tricostularia davisii	2.6-3.9	1.2-2.0	no	glabrous	3	1.4-1.9	hairy
Tricostularia drummondii	?	?	?	?	3	?	hairy
Tricostularia exsul	6.4-7.3	3.6-4.1	no	glabrous	3	2.8-3.2	hairy
Tricostularia lepschii	unknown	unknown	unknown	unknown	3	unknown	hairy
Tricostularia neesii	5.4-6.3	3.0-3.5	no	glabrous	3	2.4-2.8	hairy
Tricostularia newbeyi	2.8-4	1.5-2.4	no	hairy towards the apical 1/3	3	1.3-1.6	hairy
Tricostularia pauciflora	2.0-3.2	0.5-1.2	no	glabrous	3	1.5-2.0	hairy
Tricostularia sandifordiana	4.4-6.1	2.3-3.2	no (scarcely)	hairy towards the apical 1/3	3	2.1-2.9	hairy
Tricostularia sp. Albany	?	?	?	?	?	?	?
Tricostularia sp. Mogumber	?	?	?	?	?	?	?
Tricostularia sp. Porongurup	?	?	?	?	?	?	?
Tricostularia sp. Two Peoples Bay	?	?	?	?	?	?	?
Xyroshoenus hornei	10-13	5-6	no	glabrous	3	5-7	hairy

(*Continued*...)

Character	**Nutlet**													**Embryo**	**C_3 / C_4**
Name	sessile / stipitate	shape	length (mm)	diam. (mm)	rib no.	ribs [description]	indumentum on faces	face texture	face colour	apex shape	apex length (mm)	indumentum on apex	embryo type	C_3 / C_4
Ammothryon grandiflorum	?stipitate	subovoid	3.2–3.8	1.8–2.2	3	raised	glabrous	smooth	brown	conical	0.5	glabrous	?	C_3
Chaetospora	stipitate	obovoid to obpyriform	1.4-2.3	1.0-1.4	3	raised	glabrous	smooth or tuberculate	brown to dark brown, red-brown, or grey	cap-like to shortly conical	0-0.15	hairy or scabrous	Schoenus-type	C_3
Chaetospora curvifolia	stipitate	obovoid	1.4-1.7	1.0-1.1	3	raised	glabrous	smooth	dark brown	cap-like	0	hairy	?	C_3
Chaetospora subbulbosa	stipitate	obovoid	1.4-1.6	1.0-1.2	3	raised	glabrous	tuberculate	brown	cap-like to shortly conical	0.15	hairy	?	C_3
Chaetospora turbinata	stipitate	obpyriform to turbinate or obovoid	1.3-2.3	1.0-1.4	3	raised	glabrous	tuberculate at apex	grey to red-brown	cap-like	0	scabrous	Schoenus-type	C_3
Morelotia	sessile	ovoid to broad ellipsoid or globose	2.1-5.4	0.8-2.3	3-5	raised or impressed	glabrous	smooth	straw-coloured or red-brown to black	depressed-ovoid, broadly subconical to pyramidal	0.5-2.0	glabrous, scaberous or hispidulous	Schoenus-type	C_3
Morelotia affinis	sessile	elliptic-obloid	2.5-3.0	1.5	3	raised	glabrous	smooth	lustrous red-brown to black	subconical	0.9	glabrous	?	C_3
Morelotia australiensis	sessile	ovoid to ellipsoid	4.9-5.4	2.0-2.3	4-5	raised	glabrous	smooth	mid-brown	broadly subconical to pyramidal	1.4	hispidulous	?	?
Morelotia gahniiformis	sessile	ovate-ellipsoid to ellipsoid	2.7-3.0	2	3	impressed	glabrous	smooth	black, slightly glossy	trigonous-pyramidal	0.7	glabrous	Schoenus-type	C_3
Morelotia involuta	sessile	ellipsoid	2.1-2.7	0.8-1.0	3	raised	glabrous	smooth	straw-coloured	cylindric to trigonous pyramidal	0.5	glabrous	?	?
Morelotia microcarpa	stipitate	obovoid to globular	1.4-1.7	0.8-1.2	3	raised	glabrous	smooth	pale brown	pyramidal or conical	0.3	glabrous	?	?
Morelotia octandra	sessile	globose	4.5-5.1	1.6-1.8	3-5	raised	glabrous	smooth	pale brown	depressed-ovoid	1.5-2.0	scabrous-pubescent	?	C_3
Tetraria	stipitate	ovoid to broad ellipsoid	1.3-11	0.5-4.5	3-4	raised	glabrous	smooth or tuberculate	pale, mid, or dark brown	cap-like, shortly conical or shortly pyramidal	0-1.3	glabrous, puberulous or hispidulous	Schoenus-type	C_3
Tetraria arundinacea	stipitate	obovoid to ellipsoid	1.3-1.7	0.5-0.7	3	raised	glabrous	smooth	mid-brown	shortly conical	0.2	puberulous	?	C_3
Tetraria capillacea	stipitate	obovoid to ellipsoid	2.1-3.5	1.0-1.5	3	raised	glabrous	smooth	pale brown	shortly pyramidal	0.3-0.4	glabrous	Schoenus-type	?
Tetraria cernuua	stipitate	obloid to obovoid	1.8-2.9	1.2-1.4	3	raised	glabrous	tuberculate in upper third	pale brown	cap-like	0	hispidulous	?	C_3

(*Continued...*)

Character	**Nutlet**												**Embryo**	**C_3 / C_4**
Name	sessile / stipitate	shape	length (mm)	diam. (mm)	rib no.	ribs [description]	indumentum on faces	face texture	face colour	apex shape	apex length (mm)	indumentum on apex	embryo type	C_3 / C_4
Tetraria thermalis	stipitate	ovoid to broad ellipsoid	9-11	4.1-4.5	3-4	raised	glabrous	smooth	dark brown	cap-like to shortly conical	0-1.3	glabrous	Schoenus-type	?
Tricostularia	stipitate	obovoid to broad ellipsoid	1.2-2.5	0.8-1.5	3	raised	puberulous, hispidulous or glabrous	smooth	mid-brown or dark brown to almost black	cap-like or shortly conical	0-0.2	puberulous or hispidulous	?	C_3
Tricostularia aphylla	stipitate	obovoid to broad ellipsoid	2.2-2.4	1.3	3	raised	puberulous	smooth	mid-brown	cap-like	0	puberulous	?	C_3
Tricostularia bennettiana	stipitate	obovoid to obpyriform	1.2-1.5	0.8-0.9	3	raised	puberulous	smooth	mid-brown	shortly conical	0.2	puberulous	?	C_3
Tricostularia compressa	stipitate	ovoid	1.6-1.8	0.9-1.0	3	raised	hispidulous	smooth	mid-brown	cap-like	0	hispidulous	?	?
Tricostularia davisii	stipitate	obovoid to obpyriform or broad ellipsoid	1.2-1.7	0.8-1.0	3	raised	puberulous	smooth	dark brown to almost black	cap-like	0	puberulous	?	?
Tricostularia drummondii	stipitate	?	?	?	3	raised	puberulous	smooth	?	?	?	?	?	?
Tricostularia exsul	stipitate	broad ellipsoid	2.5-2.8	1.3-1.5	3	raised	puberulous	smooth	mid-brown to dark brown	shortly conical	0.2	puberulous	?	?
Tricostularia lepschii	stipitate	broad ellipsoid	2	1.3	3	raised	puberulous	smooth	mid-brown	cap-like	0	puberulous	?	?
Tricostularia neesii	stipitate	obovoid to obpyriform	1.9-2.2	0.8-1.0	3	raised	minutely puberulous	smooth	mid-brown	cap-like	0	puberulous	?	?
Tricostularia newbeyi	stipitate	obovoid to broad ellipsoid	1.8-2	1-1.3	3	raised	puberulous	smooth	mid-brown	cap-like	0.2	puberulous	?	?
Tricostularia pauciflora	stipitate	obovoid to obpyriform or broad ellipsoid	2.1-2.5	1.2-1.5	3	raised	puberulous	smooth	mid-brown to dark brown	shortly conical	0	puberulous	?	C_3
Tricostularia sandifordiana	stipitate	obovoid to obpyriform	1.7-2.1	0.8-1.1	3	raised	glabrous	smooth	mid-brown	cap-like	0.2	glabrous	?	?
Tricostularia sp. Albany	?	?	?	?	?	?	?	?	?	?	?	?	?	?
Tricostularia sp. Mogumber	?	?	?	?	?	?	?	?	?	?	?	?	?	?
Tricostularia sp. Porongurup	?	?	?	?	?	?	?	?	?	?	?	?	?	?
Tricostularia sp. Two Peoples Bay	?	?	?	?	?	?	?	?	?	?	?	?	?	?
Xyroshoenus hornei	sessile	subovoid	1.5-1.7	1	3	raised	glabrous	smooth	dark brown	cap-like	0.3	hispidulous	?	?