**Netrostylis**, a new genus of Australasian Cyperaceae removed from **Tetraria**

Russell L. Barrett¹⁻³ Jeremy J. Bruhl⁴ and Karen L. Wilson¹

¹National Herbarium of New South Wales, Royal Botanic Gardens, Sydney, Mrs Macquaries Road, Sydney, New South Wales 2000, Australia
²Australian National Herbarium, Centre for Australian National Biodiversity Research, GPO Box 1600, Canberra, Australian Capital Territory 2601
³School of Plant Biology, Faculty of Science, The University of Western Australia, Crawley, Western Australia 6009
⁴Botany and N.C.W. Beadle Herbarium, University of New England, Armidale, New South Wales 2351, Australia

Author for Correspondence: russell.barrett@rbgsyd.nsw.gov.au

**Abstract**

A new genus, *Netrostylis* R.L.Barrett, J.J.Bruhl & K.L.Wilson is described for Australasian species previously known as **Tetraria capillaris** (F.Muell.) J.M.Black (Cyperaceae tribe Schoeneae). The genus is restricted to southern and eastern Australia, and the North Island of New Zealand. Two new combinations are made: *Netrostylis capillaris* (F.Muell.) R.L.Barrett, J.J.Bruhl & K.L.Wilson and *Netrostylis halmaturina* (J.M.Black) R.L.Barrett, J.J.Bruhl & K.L.Wilson. *Netrostylis* is a member of the *Lepidosperma* Labill. Clade.

**Keywords:** Cyperaceae; *Netrostylis*; *Tetraria*; *Neesenbeckia*; *Machaerina*; Schoeneae; Australia; New Zealand.

**Introduction**

Recent molecular phylogenetic studies in Cyperaceae have greatly increased our understanding of relationships in the family (Muasya *et al.* 2009; Muasya 2016; Larridon *et. al.* 2018a, 2018b, 2019; Barrett *et al.* 2019, 2021; Semmouri *et al.* 2019; Elliott *et al.* 2021; Larridon *et al.*, 2021a, 2021b). This paper provides a new generic name for a segregate group of Australasian species previously included in **Tetraria**, which molecular data have consistently shown to be unrelated to **Tetraria s. str.** Detailed studies of Australasian taxa in the *Lepidosperma* Labill. clade have consistently resolved **Tetraria capillaris** (F.Muell.) J.M.Black sister to the monotypic South African genus *Neesenbeckia* Levyns. These two taxa form a clade sister to the predominantly Australasian genus *Lepidosperma* and these three form a clade sister to the more widespread genus *Machaerina* Vahl. (Larridon *et al.* 2021b). The now established phylogenetic position of **Tetraria capillaris** was first recovered by Slingsby and Verboom (2006) and Verboom (2006). The genus **Tetraria** (sensu Levyns 1947, Bruhl 1995 or Goetghebeur 1998) has subsequently been significantly redefined, but remains paraphyletic (Slingsby and Verboom 2006; Verboom 2006; Barrett *et al.* 2012a; Viljoen *et al.* 2013; Elliott and Muasya 2017, 2018, 2019, 2020; Elliott *et al.* 2019, 2021). The nomenclatural changes proposed here are made in advance of a revised global classification of the family Cyperaceae with the aim of circumscribing a monophyletic **Tetraria** (Larridon *et al.* 2017, 2018b, 2021b; Elliott *et al.* 2021).
Tetraria capillaris has endured a rather tortuous history of generic placement in tribe Schoeneae. Originally described by Hooker (1858) as Chaetospora capillacea Hook.f., a name pre-dated by Chaetospora capillacea Nees (1834), Mueller (1875) recognised that a new epithet was required and created the name Chaetospora capillaris F.Muell. Following this, the generic placement has been in a state of regular flux. Bentham (1878) transferred this species to Elynanthus P.Beauv. ex T.Lestib.; Clarke (in Cheeseman, 1906) transferred it to Cladium P.Browne; Fernald (1923) placed it in Mariscus Scop.; Black (1934) placed it in Tetraria where it has generally been accepted (e.g. Moore and Edgar 1970; Rye 1987; Wilson 1993, 1994; Wheeler and Graham 2002); but Koyama (1956) transferred it to Machaerina Vahl. Koyama (1956) was the only one of these authors to correctly identify the relationship of this species with the Lepidosperma clade. The only other named species in this complex was originally named Heleocharis (Eleocharis) halmaturina J.M.Black by Black (1927) and subsequently transferred to Tetraria by Black (1943). Tetraria monocarpa (J.M.Black) J.M.Black does not belong to this complex, rather it is a synonym of Schoenus carsei Cheeseman (Blake 1943), which is superficially similar to Tetraria capillaris.

Netrostylis species have a particularly distinctive persistent style base, similar to those found in Tetraria s. str. and this is the main reason that Netrostylis was included in Tetraria by Black (1934) and this classification was supported by Blake (1943) based on the same character state. Blake (1943) noted the nearly distichous glumes, only one barren flower and minute hypogynous bristles present in some species. However, he particularly emphasised the persistent style base as a character shared with Tetraria. The habit is very different from Tetraria, more like that of Neesenbeckia and some Machaerina and Lepidosperma species where the leaves are reduced to bracts and the culms are terete or angled. These similarities are sufficiently close that Bentham (1878) included some material of Netrostylis in his new species Lepidosperma leptostachyum Benth. (Barrett and Wilson 2012).

Netrostylis is sister to the monotypic genus Neesenbeckia Levyns, endemic to the Cape Province of South Africa, which has a 6-fid style and the persistent style base on the nutlet is prominently 6-ribbed, smooth and white (Browning and Goetghebeur 2017). Netrostylis is allied to Lepidosperma, a genus with a very similar distribution that can be distinguished by the six (or three in L. forsythii A.A.Ham.) thickened, divided hypogynous scales at the base of the nutlet (Barrett et al. 2012c). Netrostylis also has affinities with Machaerina Vahl (including Baumea Gaudich.) which can be distinguished by the new ramets growing out at similar depth to parent ramet, fruit with spongy exocarps, and the lack of a fusiform, persistent style base (Larridon et al. 2021b).

Methods

Relevant specimens have been examined by the authors at: AD, AK, B, BM, BRI, CANB, CHR, DBN, FI, G, HO, HBG, K, L, LD, MEL, NE, NSW, P and PERTH. The description is based on herbarium material, however N. capillaris and N. halmaturina have also been examined in the field by the authors.

Key to genera in the Lepidosperma clade

1. Two middle glumes larger than others; perianth of 6 bristles equal to or longer than the nutlet; stigma 6-fid .........................................................Neesenbeckia

1: Glumes of increasing length from the base, upper glumes the largest; perianth of thickened scales persistent at base of nutlet or bristles 0–5, shorter than the nutlet; stigma (2-)3-fid .................................Lepidosperma

2. Perianth of thickened scales persistent at base of nutlet; style base usually cap-like on nutlet (conical to pyramidal only in L. evansianum and L. rostratum) ...........................................Machaerina

2: Perianth absent, of flattened scales, or of 1–5 bristles; style base persistent, shortly pyramidal or spindle-like.................................................Netrostylis

3. New ramets growing out at similar depth to parent ramet; style base shortly pyramidal (continuous with nutlet apex) .................................................Neesenbeckia

3: New ramets growing out above parent ramet (candelabriform); style base spindle-shaped (constricted at base) .......................................................Netrostylis
**Taxonomy**

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

**Type species:** *Netrostylis capillaris* (F.Muell.) R.L.Barrett, J.J.Bruhl & K.L.Wilson (based on *Chaetospora capillaris* F.Muell.).

Tufted stoloniferous perennials, usually less than 1 m high (rarely to 1.6 m), rhizome tightly clumping to spreading, new culms within a ramet arising slightly higher than the parent culm resulting in a compact candelabrum arrangement. New ramets forming from long rhizomes. Culms scapose. Culms and leaves erect to spreading, terete or quadrangular, capilliform and decumbent to rigid and erect. Leaves basal; blade usually strongly reduced on the sheath (rarely to 3 cm long), ligule present, cleft. Inflorescence open or contracted paniculate, usually pseudolateral (sometimes appearing to be terminal and spicately condensed), usually with few spikelets. Primary bracts usually short, occasionally long, sheathing, often sub-erect. Spikelets with several spirally arranged, long persistent glumes of increasing length, upper 1 or 2 glumes each subtending a flower, enclosed by the wings of the next glume. Lower flower functionally male, upper (occasionally 2) flower(s) bisexual. Bristles absent or filiform. Hypogynous scales present, united and thickened only at the base, forming a small ring or cup fused to the base of the nutlet, sometimes producing 3 flat scales or up to 5 filiform, barbellulate bristles; Stamens 3. Style (2-)3-fid, hairy; style base distinct, much thickened, persistent, papillose-tuberculate. Nutlet ovate, rounded 3-angular, surface usually smooth below, usually scabrous on persistent, spindle-shaped style base. (Figures 1, 2)

**Diagnostic characters:** Related to *Neesenbeckia* Levyns, differing in the style being (2-)3-fid (*vs* 6-fid); the style base being spindle-shaped (*vs* variously swollen and 6 ribbed), usually papillose (*vs* glabrous), and brown (*vs* white); 3 stamens (*vs* 6); and candelabiform, slender (*vs* lateral, robust) rhizomes.

**Distribution:** A genus of about eleven species in Australia and New Zealand, most still undescribed (Barrett *et al.* 2012b). A revision currently in preparation plans to recognise five species endemic to south-western Australia, three species endemic to south-eastern Australia, two species endemic to north-eastern Australia and one endemic to New Zealand.

**Etymology:** Derived from the Greek *netron* (spindle) and *stylis* (style) in reference to the spindle-shaped style base persistent on the nutlets of this genus. Thus derived, *Netrostylis* is feminine (see Turland *et al.* 2018; Art. 62.2) as is *Tetraria*, so no alterations of epithet terminations are required for the two species transferred from that genus.

![Fig. 1. A. *Netrostylis capillaris* spikelet (sp) with emergent style branches (sbr) and mature nutlet (nl) with ring-like persistent perianth (pr) and stout, elongated style base (sb). B. *Netrostylis halmaturina* fertile glumes (gl); immature style base (persistent base on nutlet with apex broken off) (sb); stamen (st); perianth filament (pf); and immature nutlet (nl). Vouchers: A: Rosebery, Tasmania, S.T. Blake 18431 (BRI A0156882); B: Cherry Gardens, South Australia, J.B. Cleland s.n. (BRI A0156881). Photos by R.L. Barrett.](image-url)
Fig. 2. *Netrostylis capillaris*. A. Habit. B. Fertile spikelet. C. Fertile glume and flower. D. Style, ovary and perianth scales. Reproduced and re-arranged from Hooker (1858: Tab. CXL).
Affinities: Most closely allied to the monotypic genus *Neesenbeckia* Levyns. *Netrostylis* is distinguished from *Neesenbeckia* by the spindle-shaped persistent style base on the nutlet. *Neesenbeckia* has a distinctive (large when young), smooth, white, persistent style base on the nutlet, which is prominently 6-ribbed, and the style is also 6-fid (Browning and Goetghhebuer 2017) versus (2-)3-fid in *Netrostylis*. The slender rhizome is characterised by an unusual candelabrum-type development. Each new shoot arises beside the parent shoot, but usually a little higher than the parent, creating a candelabrum shape. These candelabrum rhizomes of *Netrostylis* are quite distinctive and make it possible to recognise the genus from sterile specimens.

*Netrostylis* is otherwise allied to *Lepidosperma* which is easily distinguished by the hypogynous scales, which are thickened at the base but not or scarcely fused around the base of the nutlet. In some *Netrostylis* species, a prominent ring or cup-shaped base fused to the nutlet (often breaking off at maturity) is probably analogous to the hypogynous scales found in *Lepidosperma*, but this structure only sometimes produces 3 broad, thin scales or up to 5 filiform bristles. *Lepidosperma rostratum* S.T.Blake is unusual in having a rostrate persistent style base covered in fine papillae somewhat similar to that of *Netrostylis* (though lacking the fusiform apex), but genetic data place this taxon within *Lepidosperma* (Barrett et al., 2012c).

*Netrostylis* also has affinities with *Machaerina* Vahl (including *Baumea* Gaudich.). *Machaerina* can be distinguished by the fruit with spongy exocarp and the lack of a fusiform, persistent style base. *Baumea* has consistently been resolved within *Machaerina* in phylogenetic studies (e.g. Viljoen et al. 2013; Larridon et al. 2021b).

*Netrostylis capillaris* s.l. is similar in appearance to *Schoenus carsei*, which has a similar distribution in New Zealand, but a more restricted distribution in southern Australia relative to *Netrostylis*. When fertile, the two are readily distinguished by the flexuous rachilla and absence of a persistent style base on the nutlet in *S. carsei*, but the differences are more subtle in sterile specimens. When fresh, the culms of *Schoenus carsei* are 'striped' longitudinally with whitish stomatal zones alternating with yellow-green non-stomatal zones, but this is less obvious when dried. The culms of *Netrostylis* are relatively uniform in colour, stomatal zones rarely being strongly evident. A leaf ligule is present in *S. carsei* and in *N. capillaris*, but in the latter there is a free limb that is cleft more or less in the middle. The persistent sheaths on the rachis are usually straw-coloured in *N. capillaris* and light to dark brown in *S. carsei*. Gardner (1998a, 1998b) provides four additional useful vegetative characters to recognise *N. capillaris* (vs *S. carsei*) in New Zealand: culms usually <0.8 (vs 0.8–2) mm diam.; pith of culms finely but distinctly septate (vs continuous); reduced leaf blade <5 (vs 10–30) mm long; and the margins at the apex of the leaf sheath minutely setose (vs glabrous). In New Zealand, these species may grow together, but in Australia, *S. carsei* tends to grow in wetter habitats than *Netrostylis capillaris*.

**Netrostylis capillaris** (F.Muell.) R.L.Barrett, J.J.Bruhl & K.L.Wilson, *comb. nov.*

**Basionym:** Chaetospora capillaris F.Muell., *Fragm.* 9: 34 (1875), based on Chaetospora capillacea Hook.f., *Fl. Tasman.* 2(2): 81 ([1858] 1859), nom. illeg. non Nees (1834); Elynanthus capillaceus Benth., *Fl. Austral.* 7: 377 (1878); Schoenus capillaris (F.Muell.) F.Muell., *Syst. Census Austral. Pl.* 128 (1882), nom. illeg., non Sw. (1788); Cladium capillaceum C.B.Clarke ex Cheeseman, *Man. New Zealand Fl.* 789 (1906); Mariscus capillaceus (Hook.f.) Fernald, *Rhodora* 25: 52 (1923); Machaerina capillacea T.Koyama, *Bot. Mag. Tokyo* 69: 63 (1956), nom. illeg., nom. superfl.; Tetraria capillaris (F.Muell.) J.M.Black, *Trans. Royal Soc. S. Austral.* 58: 169 (1934).

**Type:** Australia: Tasmania: Dry sandy banks by the Kermandie [River], Hospital Bay, south Huon River, [1850s], A.F. Oldfield 145 (holo: K 000960101!).

**Notes:** The earliest published epithet for this species, *Chaetospora capillacea* Hook.f. was illegitimate at the time of publication, being a later homonym of *Chaetospora capillacea* Nees (1834), and therefore cannot be transferred to *Netrostylis*, thus the combination is based on Mueller's (1875) replacement epithet.

We have only located a single specimen matching the protologue, so we consider the cited specimen to be a holotype. It bears pencil drawings of the spikelets typical of those made by Hooker, and matching those published with the original description (Figure 2).

**Netrostylis halmaturina** (J.M.Black) R.L.Barrett, J.J.Bruhl & K.L.Wilson, *comb. nov.*

**Basionym:** Eleocharis halmaturina J.M.Black, *Trans. Royal Soc. S. Austral.* 51: 378 (1927) (as Heleocharis); Tetraria halmaturina (J.M.Black) J.M.Black, *Fl. S. Austral.* (edn 2): 1: 153 (1943).

**Type:** South Australia: Kangaroo Island: Rocky River, 18 November 1924, J.B. Cleland s.n. (holo: AD 98018480!; iso: K 000960102!).

**Notes:** There is only a single collection at AD matching the protologue, and it is unlikely that the duplicate at K had been distributed at AD 1924 when the species was described, so we consider these sheets to be a holotype and isotype respectively.
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