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Saxipoa and *Sylvipoa* – two new genera and a new classification for Australian *Poa* (Poaceae: Poinae)

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Abstract. Two species are removed from the genus *Poa* in Australia on the basis of morphology and DNA and placed in new genera. One is placed in *Saxipoa* Soreng, L.J.Gillespie & S.W.L.Jacobs – type: *S. saxicola* (R.Br.) Soreng, L.J.Gillespie & S.W.L.Jacobs; and one is placed in *Sylvipoa* Soreng, L.J.Gillespie & S.W.L.Jacobs – type: *S. queenslandica* (C.E.Hubb.) Soreng, L.J.Gillespie & S.W.L.Jacobs. An infrageneric classification of *Poa* is proposed that places all 41 indigenous Australian species in *P.* subg. *Poa* supersect. *Homalopoa* sect. *Brizoides*. Thirty-three of these species, plus six species of New Zealand *Poa*, are placed in a new *P.* subsect. *Australopoa* Soreng, L.J.Gillespie & S.W.L.Jacobs. Two species are placed in *P.* subsect. *Austrofestuca* (Tzvelev) Soreng, L.J.Gillespie & S.W.L.Jacobs, one in *P.* subsect. *Brizoides* (Pilg. ex Potztal) Soreng, L.J.Gillespie & S.W.L.Jacobs, and one in *P.* subsect. *Neuropoa* (Clayton) Soreng, L.J.Gillespie & S.W.L.Jacobs.

Introduction

The genus *Poa* L. has some 500 species distributed worldwide. There is no worldwide revision of the genus; however, it has been revised for major regions: Burma (Myanmar) to Iraq (Bor 1952*a*, 1952*b*, 1960, 1968, 1970), Australia (Vickery 1970; Walsh *et al*. 2009), USSR (Tzvelev 1976), New Zealand (Edgar 1986; Edgar and Connor 2000), Europe and Turkey (Edmondson 1980, 1985), Malesia (Veldkamp 1994), Himalayas (Rajbhandari 1991), New World (Soreng *et al*. 2003), North America north of Mexico (Soreng 2007), China (Zhu *et al*. 2006) and southern South America (Zuloaga *et al*. 2008). *Poa* is 1 of 21–23 genera accepted in tribe Poeae subtribe Poinae (including Cinninae) (Soreng *et al*. 2007; Gillespie *et al*. 2008; Davidse *et al*. 2009). Within Australian Poinae, beyond *Poa*, four other genera are sometimes recognised; *Austrofestuca* (Tzvelev) E.B.Alexeev, *Festucella* E.B.Alexeev, *Hookerochloa* E.B.Alexeev and *Neuropoa* Clayton.

Poa in Australia was revised by Vickery (1970), where the species are commonly called tussock or snow grasses. She recognised 34 endemic (19 newly described), and five introduced species established in Australia. Seven additional endemic species were described (Morris 1989; Walsh 1991, 2008; Weiller *et al*. 2005), and two more native species were added with the inclusion of *Austrofestuca* s.s. in *Poa* (Gillespie and Soreng 2005; Jacobs *et al*. 2008, one of which is also indigenous to New Zealand). One species was removed to genus *Neuropoa* (Clayton and Renvoize 1986), although it is still generally treated as *Poa fax* Willis & Court in Australian works (Sharp and Simon 2002). For the 40 species of *Poa* accepted by Walsh *et al*. (2009), plus two transferred to *Poa* from *Austrofestuca* (Jacobs *et al*. 2008), native to Australia, only two sectional names have been applied. Two species are encompassed within *P.* sect. *Austrofestuca* (Tzvelev) Soreng & L.J.Gillespie, and one species in *P.* sect. *Brizoides* Pilg. ex Potztal.

Several studies have evaluated the monophyly of the genus *Poa* using plastid DNA data (Soreng 1990; Gillespie and Soreng 2005; Gillespie *et al*. 2007, in press) or plastid and nuclear ribosomal (nr) DNA data (Gillespie *et al*. 2008; Soreng *et al*. in press). Considerations of morphological characteristics (Soreng and Gillespie 2007; Jacobs *et al*. 2008), along with plastid and nrDNA phylogenetic hypotheses (Gillespie and Soreng 2005; Gillespie *et al*. 2007, 2008), have lead us to treat several genera within *Poa* (e.g. *Anthochloa* Nees & Meyen, *Austrofestuca s.s.*, *Eremopoa* Roshev., *Neuropoa*, *Parodiochloa* C.E.Hubb., and *Tzvelevia* E.B.Alexeev), and exclude a few elements from it (e.g. *Arctopoa* (Griseb.) Prob., *Bellardiochloa* Chiov., *Nicoraepoa* Soreng & L.J.Gillespie, and *Austrofestuca* pro parte non typica (= *Hookerochloa* including *Festucella*)).

The following nine Australian *Poa* species were sampled in published molecular studies of the genus and resolved within what we now call *P.* subg. *Poa* supersect. *Homalopoa* (Dumort.) Soreng & L.J.Gillespie. Two to five species of similar

[†]Deceased.

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morphological form (*P. fawcettiae* Vickery, *P. labillardierei* Steud., *P. poiformis* (Labill.) Druce, *P. porphyroclados* Nees, *P. sieberiana* Spreng.) were informally discussed as group 'Australopoa', a name used to cover the majority of Australian *Poa* (Soreng 1990; Gillespie and Soreng 2005; Gillespie *et al*. 2007, 2008). *P. drummondiana* Nees of *P.* sect. *Brizoides*, and *P. fax* (≡ *Neuropoa fax* (Willis & Court) Clayton), were recognised as morphologically isolated species within *P.* supersect. *Homalopoa* (Gillespie *et al*. 2008). *P. billardierei* St-Yves and its segregate species *P. pubinervis* (Vickery) S.W.L. Jacobs, formerly treated as *Austrofestuca s.s.*, were resolved within *Poa* subg. *Poa* supersect. *Homalopoa* (Hunter *et al*. 2004; Gillespie and Soreng 2005; Gillespie *et al*. 2007, 2008).

DNA data revealed that *Austrofestuca s.l.*, *sensu* Jacobs (1990: incl. *A. eriopoda* (Vickery) S.W.L.Jacobs, *A. hookeriana* (F.Muell. ex Hook. f.) S.W.L.Jacobs, *A. littoralis* (Labill.) E.B.Alexeev, and *A. pubinervis* (Vickery) B.K.Simon) was polyphyletic (Hunter *et al*. 2004; Soreng *et al*. 2007; Gillespie *et al*. 2008). *Austrofestuca s.s.* was subsequently treated as *P.* sect. *Austrofestuca* (Gillespie and Soreng 2005; Jacobs *et al*. 2008), encompassing the latter two species (as *P. billardierei* and *P. pubinervis*; Jacobs *et al*. 2008). For the other two species, the genera *Hookerochloa* and *Festucella*, described by Alexeev (1985), were resurrected (Hunter *et al*. 2004; Soreng *et al*. 2007; Gillespie *et al*. 2008). *Hookerochloa* was then expanded to include *Festucella* (Jacobs *et al*. 2008) because the morphological characters used to separate the two species were deemed unsatisfactory for distinguishing them as separate genera (Jacobs *et al*. 2008).

Newer DNA data for subtribe *Poinae* led us to re-examine relationships of *Poa* and Poinae genera in Australia. The DNA data are presented in detail in a parallel paper (Gillespie *et al*. 2009). The present paper deals with taxonomic changes implied by the new molecular data and morphological considerations.

Results and discussion

We have come to several conclusions about the morphology of *Poa* in this Austral region as discussed below. Results from a parallel DNA investigation (Gillespie *et al*. 2009) are briefly outlined as supporting data.

As assessed by our study of specimens (herbarium collections of *Poa* and *Hookerochloa* at MEL, NSW and US), and literature for Australian and New Zealand *Poa* and Poinae genera (Vickery 1970; Jacobs and Hastings 1983; Morris 1989; Walsh 1991, 2008; Weiller *et al*. 1995, 2005; Sharp and Simon 2002), 33 of the endemic Australian *Poa* species not already placed in sections or other genera are fairly homogeneous in morphology. These were informally called group Australopoa (Soreng 1990). The same morphological-character pattern in these 33 species applies to six species native to New Zealand (Edgar 1986, Group C).

Collectively, these 39 species are perennial, mostly caespitose, tussock-forming grasses. Most of the species are tightly tufted without elongated lateral shoots. A few species are short-rhizomatous and loosely tufted. Several species branch at aerial culm nodes, called 'vertical rhizomes' by Vickery (1970), or stool by the layering and rooting at these aerial nodes. This aerial branching habit is facultative in most of these species and environmentally induced in some (Vickery 1970), whereas it is normal in *P. tenera* Hook.f, *P. jugicola* D.I. Morris and *P. orthoclada* N.G.Walsh. Aerial culm branching is otherwise rare and facultative in *Poa*. The culm bases are not bulbous or corm-like (except in *P. crassicaudex* Vickery). The leaf blades are generally slender, soft (although not lax) in a few, to moderately firm to moderately rigid; an abaxial keel is apparent but neither prominent nor deep; in cross-section the leaf blades are flat or more commonly V-shaped, or folded, sometimes with inrolled margins, adaxially with one row of bulliform cells on either side of the midrib, and the apices slender, and obscurely to distinctly naviculate. The top culm leaf sheath margins are fused mostly between 8 and 33% the length. Fusion is between 33 and 44% in a few Australopoa species, and between 15 and 60% in New Zealand group C species (Edgar 1986). Among these 39 species, top culm sheath margins generally tend to be fused for more of the length in species with primarily extravaginally branching vegetative shoots than in those with primarily or strictly intravaginal shoots. (In Australian *Poa* not included in the Australopoa group, the sheaths of *P. fordeana*, *P. homomalla*, *P. orba* and *P. sallacustris* are closed 39–90% (branching all or primarily extravaginal), of *P. drummondiana* ~37% (extravaginal), of *Poa billardierei* and *P. pubinervis* ~33% (intravaginal) and of *P. fax* ~10−80% (unusually variable because of shortness of sheaths) (intravaginal)). The ligules are generally scarious and a bit thicker than average for the genus, short (infrequently long in *P. hookeri*), abaxially scabrous or hairy (common in *Poa*), with the apex truncate and generally asperous or ciliolate to ciliate (hairs up to 0.2 mm in some species). The panicles are loosely contracted to wide open (rarely contracted in *P. poiformis*), with spikelets in the distal halves of the branches. The panicle branches are scabrous, with hooks (hirtellous pubescence in some) usually scattered over the surface (i.e. not confined to angles). The spikelets are mostly 3.5–7 mm long, oblong or ovate, and laterally compressed (not plump or turgid). The rachilla is generally smooth and glabrous, and occasionally sparsely to moderately puberulent. The outer margins of the glume and lemma are smooth or sparingly to moderately scaberulous to scabrous, or infrequently sparingly ciliolate or ciliate below. The lemmas are somewhat firmly membranous or infrequently slightly subchartaceous, with a narrow scarious to hyaline margin that widens into the apex, 5-veined (rarely 7-veined), with lateral veins distinct but not raised, and the lemmas are usually softly pubescent at least on the keel and lateral veins below (rarely consistently glabrous throughout in *P. serpentum* Nees, and in some forms of *P. labillardierei*, *P. tenera*, *P. meionectes* and *P. clivicola*), usually somewhat scabrous above, and unawned. In species with hairs between the lemma veins, the hairs often also occur between the marginal veins and margins, and on the margins. The floret callus, in at least the most fully developed proximal florets of a spikelet, is usually webbed (with a dorsal tuft of crinkly hairs, the web of hairs sometimes scant or reduced to one or a few short hairs). The callus is rarely consistently glabrous throughout a species. The palea is adherent to the caryopsis. The palea keels are scabrous at least distally, and frequently puberulent in the midsection, with hairs more or less in a single file, and the surface between the keels is often puberulent. The lodicules are oblanceolate with a small lateral lobe, and glabrous. The

flowers are perfect (the more substantially reduced distal ones may be infertile). The anthers are mostly of middle range of lengths for *Poa* (1.2–3 mm), although they are not <1 mm. The caryopses are usually 1.5–2.2(–2.5) mm long, adherent to the palea, with the apex glabrous and narrow-shouldered, tapering to narrowly separated style bases, the ventral sulcus is shallow and has a basal hilum that is round and 0.2–0.3(–0.5) mm long.

As noted above, species conforming to the above morphological pattern have informally been discussed as group Australopoa (Soreng 1990). The placement of six New Zealand species within this Australopoa group is supported by the morphological grouping of these species by Edgar (1986) in her Group C, in which she also included the Australian Australopoa species, *P. labillardierei* Steud. and *P. sieberiana* Spreng., that are naturalised in New Zealand, and by DNA data linking these New Zealand and Australian species (see below). Expansion of this group to include more recently published New Zealand *Poa* Group C species (Edgar and Connor 2000) requires additional study, because some characters differ (e.g. presence of dicliny).

Australian *Poa* species that significantly break from the above description of group Australopoa are *P. billardierei* St-Yves, *P. drummondiana* Nees, *P. fax*, *P. fordeana* F. Muell., *P. homomalla* Nees, *P. pubinervis* (Vickery) S.W.L. Jacobs, *P. queenslandica* C.E.Hubb. and *P. saxicola* R.Br, and two recently described taxa, *P. orba* N.G.Walsh and *P. sallacustris* N.G.Walsh. *P. billardierei* (≡ *Festuca littoralis* Labill., *Austrofestuca littoralis*, *P. triodioides* Zotov; Alexeev 1976, 1987), and the segregated species *P. pubinervis*, are both currently placed in *P.* sect. *Austrofestuca* (Gillespie and Soreng 2005; Jacobs *et al*. 2008). The latter two species differ in several ways from other *Poa* (see Hunter *et al*. 2004; Gillespie and Soreng 2005; Soreng and Gillespie 2007), likely because of adaptations to their sand-dune habitat (convergent with *P. macrantha* Vasey of North America, *P.* sect. *Madropoa* Soreng). *P. drummondiana* was placed in its own section, *P.* sect. *Brizoides*, on the basis of its large plump spikelets and corm-like swellings of the culm bases. *P. fax* was segregated as genus *Neuropoa*, owing to its annual habit, contracted panicles, firm, strongly 9–11-nerved lemmas and soft flaccid leaf blades (Clayton 1985; Clayton and Renvoize 1986). *P. homomalla* differs from Australopoa species, and most of the other Australian taxa mentioned above, by its elongated rhizomes producing isolated flowering shoots, sheaths that are compressed, strongly keeled and closed to near the throat, ligules that are scarious–hyaline and up to 7 mm long, with smooth glabrous margins, and calluses that are glabrous. The latter species shares rhizome and sheath characteristics with *P.* sect. *Macropoa* F.Herm. ex Tzvelev and *Homalopoa* Dumort. *s.s.*, of Eurasia and Eurasia and North America, respectively. *P. fordeana* (≡ *Glyceria fordeana* (F.Muell.) Benth.) is rhizomatous, with sheaths moderately keeled and compressed, closed in the upper half, ligules scarious–hyaline and up to 5 mm long, with smooth glabrous margins, callus generally with a relatively broad, dense tuft of dorsal hairs that is usually <10% the lemma in length, the callus hairs undifferentiated and indistinctly isolated from the appressed silky hairs of the keel. This species is perhaps allied to *P. homomalla*, and the recently described *P. sallacustris* (Walsh 1991). The recently described *P. orba* was suggested to be unlike all other Australian species. From reading Weiller *et al*. (2005), we initially thought it belonged to *Poa* subg. *Poa s.s.* (Gillespie *et al*. 2008); however, we could not place it further. We have now examined specimens of all of these, and included all the above widely variant taxa in DNA analyses.

Enlarging on our previous DNA sample of *Poa* species from Australia (see Introduction), we now have molecular sequence data for 26 species of *Poa* from Australia (18 of Australopoa), 21 species from New Zealand (5 of Australopoa) and fairly deep sampling in the genus *Poa* and related genera from around the World (Gillespie and Soreng 2005; Gillespie *et al*. 2007, 2008, 2009; R. J. Soreng, L. J. Gillespie, unpubl. data). Here, we briefly summarise the DNA phylogenetic results presented in more detail in a parallel paper on the DNA analysis of Australian *Poa* (Gillespie *et al*. 2009). The plastid (trnT–trnL–trnF or TLF) and nuclear (nr) (ITS and ETS) DNA genotypes of all tested Australian species, except the two discussed below, can be characterised as belonging to *Poa* subg. *Poa*. The plastid analysis further characterises the species as belonging to supersect. *Homalopoa*.

Analysis of nrDNA (Gillespie *et al*. 2009) resolved a subclade within subg. *Poa* of 18 Australian Australopoa species (*Poa affinis* R.Br., *P. amplexicaulis* C.M.Weiller & Stajsic, *P. cheelii* Vickery, *P. clelandii* Vickery, *P. costiniana* Vickery, *P. ensiformis* Vickery, *P. fawcettiae*, *P. helmsii* Vickery, *P. hiemata* Vickery, *P. hookeri* Vickery, *P. labillardierei*, *P. lowanensis* N.G.Walsh, *P. meionectes* Vickery, *P. orthoclada* N.G.Walsh, *P. phillipsiana* Vickery, *P. poiformis*, *P. porphyroclados*, *P. sieberiana*) and five New Zealand Group C species Australopoa (*P. anceps* Forst. f., *P. chathamica* Petrie, *P. cita* E.Edgar, *P. cockayneana* Petrie, *P. litorosa* Cheeseman), together with *P. billardierei*, *P. drummondiana*, *P. fax*, *P. fordeana*, *P. homomalla*, *P. orba*, *P. pubinervis* and *P. sallacustris* from Australia, and *P. keysseri* from New Guinea, and no others. Fifteen other New Zealand species analysed, belonging to Edgar's Groups A1, A2, B, D, E1, E2 and F2, have different nrDNA types that do not resolve within the subg. *Poa* clade.

In a plastid analysis, in the majority of most parsimonious trees (Gillespie *et al*. 2009), all 26 Australian species tested (and sometimes the one New Zealand Group C species tested with a full TLF sequence; *P. cockayneana*) formed two subclades within the subg. *Poa* supersect. *Homalopoa* clade, supported by one character each. One species from New Guinea, *P. keysseri*, and no other tested species from around the world, was resolved in these same two subclades with the Australian species. Within the plastid *Homalopoa* clade there was little DNA variation, and most internal structure collapsed in the strict consensus tree. The five tested New Zealand species of Edgar's other groups also had *Homalopoa* plastid types; however, these species neither formed a clade with any of the above species nor among themselves. In combined plastid and nrDNA analyses (Gillespie *et al*. 2009), *Neuropoa*, *P.* sects. *Austrofestuca* and *Brizoides*, and all Australopoa group species were resolved in a single subclade within *Poa* subg. *Poa* supersect. *Homalopoa* that excluded all other tested *Poa* taxa, again except for *P. keysseri*, and New Zealand Group C taxa.

Regardless of whether the plastid or nrDNA data were separated or combined, two Australian *Poa* species, *P. queenslandica* and *P. saxicola*, resolved outside the genus *Poa* (Gillespie *et al*. 2009). These two species were nested in a clade with a subset of other genera of subtribe Poinae (Gillespie *et al*. 2008), including the Australian genus and species *Hookerochloa hookeriana* (F.Muell. ex Hook.f.) E.B.Alexeev and *H. eriopoda* (Vickery) S.W.L.Jacobs (≡ *Festucella eriopoda* (Vickery) E.B.Alexeev), the arctic genus *Arctagrostis* Griseb., and the South American genus *Nicoraepoa. Poa queenslandica* and *P. saxicola* are morphologically isolated from each other, from all the other *Poa* taxa discussed above and from other genera of subtribe Poinae. Here, we propose separating these two species from *Poa*, and placing each in a new genus.

Taxonomy

Two new genera excised from Poa

Sylvipoa Soreng, L.J.Gillespie, & S.W.L.Jacobs, gen. nov. (Figs 1*D*, 2)

A *Poa* vaginis non connatis, laminis frequenter sparsim tessellatis, callo tereti leviterque a dorso compresso cum corona pilorum minutorum (usque ad 0.2 mm longorum), lemmatibus non a lateribus compressis cum nervis elevatis marginibusque attinentibus, differt. Typus: *Sylvipoa queenslandica*.

Slender, loosely tufted *perennials*, without rhizomes or stolons. *Young shoots* extravaginal with several cataphylls. *Leaves* mostly cauline; *sheaths* open to the nodal band; *auricles* and *contra-ligules* absent; *ligule* scarious, abaxially smooth (or with sparse hooks proximally), glabrous, apex entire or lacerate, truncate, smooth, glabrous; *blade* flat, broad, linear, with frequent cross-veins between nerves, cross-veins faint or plainly evident. *Inflorescence* a compound panicle, open, effuse, *branches* widely spreading. *Spikelets* lanceolate or oblong, slightly laterally compressed, disarticulating above the glumes and below each floret; 2–4(–7)-flowered. *Glumes* keeled, slightly scabrous on the keels, smooth elsewhere, surfaces membranous, margins scarious, smooth or sparingly scaberulous; *lower glume* 1–3-nerved, lateral nerves distinct, apex acute; *upper glume* 3-nerved, apex acute. *Rachilla* internodes slender, slightly dorsiventrally compressed to terete, short, densely scaberulous. *Callus* with a minute crown of hairs; *scar* round to slightly dorsiventrally compressed, truncate. *Lemmas* lanceolate to oblong, membranous, 5-nerved, strongly keeled, and indistinctly laterally compressed; lateral nerves prominent, raised, extending to near the apex, scaberulous, internerves membranous, scaberulous, apex obtuse or acute, unawned. *Palea* 90% of lemma length to slightly exceeding the lemma, keels scaberulous in the upper 80%, between keels densely scaberulous, flat or slightly concave or convex. *Lodicules* 2, scarious–hyaline, broadly lanceolate, laterally lobed. *Stamens* 3. *Ovary* glabrous, styles 2, apical, bases recurving, white, sparse, the longer primary branches with secondary branching. *Caryopsis* free from the palea, fusiform, brown, hard; sulcus shallow to absent; *hilum* basal, round punctiform.

Sylvipoa queenslandica (C.E.Hubb.) Soreng, L.J.Gillespie, & S.W.L.Jacobs, comb. nov. *Basionym*: *Poa queenslandica* C.E.Hubb. in Bull. Misc. Inform. 1934: 449 (1934). *Typus*: Australia: Queensland: Spring Creek, near Killarney, on mountain slope, in rain forest, at foot of water-fall amongst basaltic boulders, Mar 1931, *C.E. Hubbard 5783* (holotype: K; isotype: BRI)

Sylva from Latin for wood, forest, woodland, and *Poa* L., Sp. Pl. 67 (1753) from the Greek *poa* (grass, especially as fodder); *queenslandica* – from Queensland. Common name: Queensland poa. Additional photo: panicle branch (Sharp and Simon 2002).

Slender, loosely tufted *perennial*, without rhizomes or stolons. *Young shoots* extravaginal with several cataphylls. *Culms* erect or geniculately ascending, 40–150 cm tall, fairly stout or somewhat slender (~1–2 mm diam.), terete or slightly compressed, smooth, glabrous, simple or with secondary branching, leafy, 5–9-noded, nodes terete, smooth, glabrous. *Leaves* mostly cauline; *sheath* mostly shorter than the internodes, margins fused only at the nodal band (fused less than 1% the length), loose, striately nerved, smooth, glabrous; basal leaf sheaths herbaceous, not becoming fibrous, with or without 0.1-mm-long retrorse hairs at the very base; *ligule* scarious, 1–4.5 mm long (2–4.5 mm on upper leaves), abaxially smooth (or with sparse hooks proximally), glabrous, apex entire or lacerate, truncate, smooth, glabrous; *blade* flat, 16–40 cm long, linear, gradually expanded from the somewhat flared base, 4–17 mm wide, thin, flaccid, blade surface smooth or sparsely scaberulous over the costae, to adaxially densely scaberulous about the flared collar, glabrous, with cross-veins as frequent as 1 per mm between nerves, cross-veins faint or plainly evident, margins closely scabrous along the length, blade apex acuminate, scabrous; *abaxial surface* with a prominently raised eccentric midrib, lateral costae slightly raised; *adaxial surface* with 20–40 low narrow costae, intercostal regions

Fig. 1. Spikelet diversity in indigenous Australian Poinae genera (numerals within taxa are standardised for the particular organ). (*A*) *Hookerochloa eriopoda* (*E.N. McKie 7449*, US): *1*, spikelet; *2*, glumes; *3*, florets; *4*, lemma and rachilla segment; *5*, palea: *5a*, ventral view; *5b*, lateral view; *6*, caryopsis, ventral view. (*B*) *Poa fordeana* (no data, US-948542): *1*, spikelet; *2*, glumes; *3*, florets; *5*, palea: *5a*, ventral view; *5b*, lateral view; *6*, caryopsis, ventral view. (*C*) *Saxipoa saxicola* (*R.A. Black 1241000(3)A*, US): *1*, spikelet; *2*, glumes; *3*, florets; *4*, lemma; *5*, palea: *5a*, ventral view; *5b*, lateral view; *6*, caryopsis: lateral view left; ventral view right; *7*, ovary and stigmas; *8*, rachilla segment; *9*, lodicule. (*D*) *Sylvipoa queenslandica* (*S.T. Blake 13796*, US): *1*, spikelet; *2*, glumes; *3*, florets; *5*, palea: *5a*, ventral view; *5b*, lateral view; *6*, caryopsis, ventral view. (*E*) *P. sieberiana* (*R. Pullen 2963*, US): *1*, spikelet; *2*, glumes; *3*, florets; *5*, palea: *5a*, ventral view; *5b*, lateral view; *6*, caryopsis, ventral view. (*F*) *P. drummondiana* (*Mrs Irvine 26*, US): *1*, spikelet; *2*, glumes; *3*, florets; *5*, palea: *5a*, ventral view; *5b*, lateral view; *6*, caryopsis and stigmas. (*G*) *P. billardierei* St-Yves (*J.E. Tilden 753*, US): *1*, spikelet; *2*, glumes; *3*, florets; *5*, palea, ventral view; *6*, caryopsis, ventral view; *7*, stigma; *8*, rachilla segment. (*H*) *H. hookeriana* (*R.A. Black* US-1937360; *H.S. McKee 10135*, whole spikelet, US): *1*, spikelet; *2*, glumes; *4*, lemmas and rachilla segments; *5*, palea; *6*, caryopsis, ventral view. (Photos R. J. Soreng).


(A)
(B)
(C)
(D)
(E)
(F)
(G)
(H)
10 mm

Fig. 2. *Sylvipoa queenslandica* (*Gillespie & B. Simon 7334*) habit (photo L. J. Gillespie).

~4 times wider than the costae; *blade cross-section* without continuous abaxial or adaxial sclerenchyma, with I-girders at least around the primary vascular bundles, without evident bulliform cells rows between the veins. *Peduncle* smooth; *inflorescence* a compound panicle, open, effuse, 12–35 cm long, 8–16 cm wide, lower axis smooth, longest internodes 3–5 cm; primary panicle *branches* widely spreading, 5–8 per node, 10–28 cm long, angled, proximally smooth or sparingly scabrous grading to distally closely scaberulous primarily along angles, with spikelets mostly in the distal half; *pedicels* up to 4–8 mm. *Spikelets* lanceolate or oblong, slightly laterally compressed, 3–6.5 mm long, disarticulating above the glumes and below each floret; 2–4(–7)-flowered. *Glumes* keeled, slightly scabrous on the keels, smooth elsewhere, surfaces membranous, margins scarious, smooth or sparingly scaberulous; *lower glume* lanceolate to ovate, 1.5–2.3 mm long, 90% length of upper glume, membranous, 1–3-nerved, lateral nerves distinct, apex acute; *upper glume* ovate to ovate-elliptical, 1.7–2.7 mm long, 65% of length of adjacent fertile lemma, 3-nerved, apex acute. *Rachilla* internodes slender (~0.1 mm diam.), slightly dorsiventrally compressed to terete, short (mostly <0.9 mm), densely scaberulous. *Callus* puberulent, with a crown of hairs up to 0.2 mm long; *scar* round to slightly dorsiventrally compressed. *Lemmas* lanceolate to oblong, 2.3–3.2 mm long, membranous, 5-nerved, strongly keeled, and indistinctly laterally compressed, green or apically with a slight tinge of purple in the apex margins and veins, lateral nerves prominent, raised, extending to near the apex, scaberulous, internerves membranous, scaberulous, margins scabrous to scaberulous, membranous below or narrowly scarious, narrowly scarious to hyaline in the distal 0.5 mm, apex obtuse or acute, unawned. *Palea* 90% of lemma length to slightly exceeding the lemma, keels scaberulous in the upper 80%, between keels densely scaberulous, flat or slightly concave or convex. *Lodicules* 2, scarious–hyaline, broadly lanceolate, laterally lobed. *Stamens* 3; *anthers* 1–1.8 mm long. *Ovary* glabrous, styles 2, apical, bases recurving, white, up to 1.5 mm long, primary branches up to 0.7 mm long, sparse, the longer ones with secondary branching. *Caryopsis* free from the palea, fusiform, 1.4–1.8 mm long × 0.4–0.5 mm wide in ventral view, brown; sulcus shallow to absent; *hilum* basal, round punctiform, 0.2 mm diam. *Chromosome number* unknown.

Flowering and fruiting: flowering November to August; fruiting March to October.

Distribution: Australia – Queensland and New South Wales (mapped as *Poa queenslandica*: Sharp and Simon 2002; Centre for Plant Biodiversity Research 2004). *Habitat*: margins and openings in temperate rainforests at altitudes usually above 400 m, and up to 1140 m.

Notes

Sylvipoa queenslandica differs from *Poa* in having sheaths open all the way to the base, blades with common cross-veins between the longitudinal vascular bundles, callus with a short crown of hairs, lemma weakly laterally compressed, with prominently raised nerves extending to near the apex, and at least from Australopoa in caryopses free from the palea. This species is quite different from all other Poinae genera in the sheaths being entirely open, the blades having cross-veins, and in the lemma form. Our new DNA data for this species indicate a possible sister relationship to *Nicoraepoa*, within a strongly supported clade with *Arctagrostis*, *Saxipoa* and *Hookerochloa*; and it is distantly related to other Poinae genera (Gillespie *et al*. 2009).

Saxipoa Soreng, L.J.Gillespie & S.W.L.Jacobs, gen. nov. (Figs 1*C*, 3)

A *Poa* glumis et lemmatibus margine et paleae carinis dense ciliatis, superficiebus lemmatum firme subchartaceis et glabris, vaginis culmis connatis solo ad basim (1–3%), differt. A *Hookerochloa* ramosis inflorescentiis brevioribus erectis, spiculis parvis, glumis et lemmatibus margine et paleae carinis dense ciliatis, lemmatibus sine arista, differt. Typus: *Saxipoa saxicola* (R.Br.) Soreng, L.J.Gillespie & S.W.L.Jacobs.

Tufted *perennials*. *Vegetative shoots* intravaginal, erect, without cataphylls and with elongated prophylls, also sometimes extravaginal, erect or slightly divergent, with several cataphylls and contracted prophylls. *Leaves* mostly basal; *sheath* slightly keeled, with moderately pronounced lateral veins, glabrous; *sheath margins* fused at the base 1–3 mm (0–3% the length); *collar*, smooth, glabrous, outer margins thick; *auricles* and *contra-ligules* absent; *ligule* brownish at base, firmly scarious, abaxially scabrous, apices irregular, margins ciliolate; *blade* folded or more or less expanded when living, mostly folded on drying, somewhat thick and firm, shallowly keeled, apex shallowly naviculate. *Inflorescence* paniculate, well exerted, contracted, linear, few-flowered. *Spikelets* broadly elliptical, plump, turgid, 2–4-flowered, slightly laterally compressed, disarticulating above the glumes and below each floret, florets closely imbricate.

Fig. 3. *Saxipoa saxicola* (*Gillespie & Jacobs 7353*). (*A*) Habit. (*B*) Spikelets along an inflorescence primary branch (photos S. W. L. Jacobs).

Glumes subequal, ovate, firmly membranous with slightly scarious apex and margins in the upper 25–35% and ciliate on the margins in the lower half; *lower glume* 1–3-veined; *upper glume* 3(–5)-veined. *Rachilla* internodes terete, stout, smooth. *Callus* slightly thickened, scar slightly angled, round to slightly laterally compressed, surfaces smooth, glabrous or often ventrally with one to several fairly straight hairs. *Lemmas* chartaceous, lower margins slightly inrolled, upper margins with narrow scarious margins and apex, 5–7-veined, marginal veins pronounced, intermediate veins faint to distinct but not raised, surfaces smooth, somewhat glossy, margin ciliate for most of the length (to scabrous above), apex acute, keel slightly inwardly arched near the apex, the keel vein sometimes bearing a brief, subapical, straight, scabrous mucro not reaching, or reaching but not exceeding, the lemma apex; *palea* ovate, slightly shorter than the lemma, subchartaceous to chartaceous, strongly keeled, keels smooth, densely ciliate. *Flowers* perfect. *Lodicules* 2, free, oblanceolate, scarious–hyaline, without lobes or with a minute lateral lobe, with or without a few apical cilia, vascularisation indistinct. *Stamens* 3. *Ovary* glabrous or with a few apical cilia; *styles* 2, apical, with slightly thickened bases, stigmas white, lanceoloid, densely plumose, without secondary branching. *Caryopsis* free from the palea, broadly elliptical to fusiform, plumply subtrigonus in cross-section, hard, ventrally with a distinct broad shallow sulcus, apex with slightly thickened style bases; *hilum* broadly elliptical, ~10–15% the grain length; *embryo* <25% the grain length.

Saxipoa saxicola (R.Br.) Soreng, L.J.Gillespie & S.W.L.Jacobs, comb. nov. Basionym: *Poa saxicola* R.Br. in Prodr. 180 (1810). *Typus*: Australia: Tasmania: Table Mountain [Mt Wellington], Mar 1804, *R. Brown 6286* (holotype: BM)

Saxi from Latin for rock, and *Poa* L., Sp. Pl. 67 (1753) from the Greek *poa* (grass, especially as fodder); *saxicola* – rock dwelling. Common name: rock poa. Additional illustrations and photos: habit, spikelet, lodicule, flower, fruit (Hooker 1860), type photo (Vickery 1970), photo of habit (Sharp and Simon 2002).

Tufted *perennial. Vegetative shoots* intravaginal, erect, without cataphylls and with elongated prophylls, also sometimes extravaginal, erect or slightly divergent, with several cataphylls and contracted prophylls. *Culms* erect, crowded, terete or slightly elliptical in cross-section, (13–) 25–60(–80) cm tall, slender (~1 mm diam. below), 1 or 2 nodes exposed, the uppermost below the middle of the culm, proximal culm nodes and internodes smooth, middle and distal culm internodes inconspicuously finely scabrous. *Leaves* mostly basal; *sheath* slightly keeled, with moderately pronounced lateral veins, glabrous; *proximal leaves* of extravaginal shoots cataphyllous, light brown, smooth or lightly scabrous over the veins; *sheath margins* of the upper culm leaf fused ~1–3% the length, smooth or lightly scabrous at least near the collars; *basal sheaths* papery becoming slightly fibrous with age, with rare to infrequent diagonal cross-veins; upper 4 or 5 *culm sheaths* open to near the base, closely investing the culm, uppermost culm sheath the longest; *collar*, smooth, glabrous, outer margins thick; *ligule* brownish at base, firmly scarious, abaxially scabrous; *ligules of lowest culm leaf and vegetative shoots* up to 1 mm, apices irregular, margins ciliolate; *ligules of middle and upper culm leaves* 2–4.5 mm, decurrent along the sheath margins, apices obtuse to acute, margins erose to lacerate, lightly asperous to ciliolate; *blade* folded or more or less expanded when living, mostly folded on drying, shallowly keeled, moderately thick and firm (in most mainland material) (somewhat softer and thinner in most Tasmanian material), straight or curved, 1–25 cm long, 2–5 cm wide, apex shallowly naviculate; *abaxial surface* smooth or nearly so, veins not pronounced, finely scabrous distally, margins indurate, white, lightly scabrous; *adaxial surface* with 4–6 indistinctly expressed veins, smooth or sparingly scabrous, intercostal regions 3–4 times broader than the costae, with a single row of bulliform cells flanking each side of the midrib; *proximal* 1 or 2 culm *blades* short, middle few elongated, the uppermost moderately reduced in length and ~30–50% of their sheaths in length; *blade cross-section* with or without a continuous thin sclerenchyma layer, with 5–9 costae, I-girders present around primary vascular bundles. *Peduncle* smooth to slightly scabrous; *inflorescence* paniculate, well exerted, contracted, linear, 4.5–15 cm long, usually with fewer than 60 spikelets, with 2–2.5 cm long proximal internodes, axis densely scabrous; *branches* 1 or 2 per node, appressed, longest 1–2 cm, few angled, densely scabrous on and between the angles, with 2–8 appressed spikelets; *pedicels* 1–1.5 mm. *Spikelets* broadly elliptical, plump, turgid, 4.5–7 mm long, 2–4-flowered, slightly laterally compressed, disarticulating above the glumes and below each floret, florets closely imbricate. *Glumes* ovate, firmly

membranous with slightly scarious apex and margins in the upper 25–35%, distinctly keeled, pale green to violaceous throughout, scabrous along the keel and on the distal scarious surfaces, margins closely scabrous to ciliate in the lower half, apices acute to slightly obtuse; *lower glume* 3.4–5 mm, 1–3-veined; *upper glume* 4.3–6 mm long, 3(–5)-veined, subequal to 10% longer than the first lemma. *Rachilla* internodes terete, 0.5–1.3 mm long, stout, smooth, proximal internode curved, densely pubescent with generally distributed fairly stiff hairs ~0.2−0.3 mm long. *Callus* slightly thickened, scar slightly angled, round to slightly laterally compressed, surfaces smooth, glabrous or often ventrally with one to several fairly straight hairs up to 0.6 mm long. *Lemmas* 3.8–5.5 mm long, ovate oblong in lateral view, laterally compressed, basal 0.4 mm membranous, main surfaces chartaceous, lower margins slightly inrolled, upper margins with narrow scarious margins and apex, 5–7-veined, marginal veins pronounced, intermediate veins faint to distinct but not raised, surfaces smooth, somewhat glossy, pale green or violaceous apically, scaberulous along the upper keel and on sides near the apex, glabrous, margin ciliate for most of the length (or scabrous above), apex acute, keel slightly inwardly arched near the apex, sometimes bearing a brief (0.1–0.2 mm), subapical, straight, scabrous mucro not reaching, or reaching but not exceeding, the lemma apex; *palea* ovate, slightly shorter than the lemma, subchartaceous to chartaceous, strongly keeled, keels basally smooth, ciliate over much of the length to the apex with more than one row of hairs, wings up to 0.5 mm deep, glossy, sometimes ciliate on the outer margin, between keels deeply sulcate, smooth or sparsely scaberulous, glabrous. *Flowers* perfect. *Lodicules* 2, free, oblanceolate, 0.6–0.7 mm long, scarious–hyaline, without lobes or with a minute lateral lobe, with or without a few apical cilia up to 0.4 mm long, vascularisation indistinct. *Stamens* 3, anthers 0.75–1.5 mm long; *Ovary* glabrous or with a few apical cilia; *styles* 2, up to 2 mm long, apical, slightly separated, with slightly thickened bases, stigmas white, lanceoloid, densely plumose, primary stigmatic branches up to 0.4 mm long, without secondary branching. *Caryopsis* free from the palea, 1.7–2.5 mm long, broadly elliptical to fusiform, plumply subtrigonus in cross-section, ventrally with a distinct broad shallow sulcus, apex with slightly thickened style bases; *hilum* broadly elliptical 0.25–0.3 mm long, ~10–20% the grain length; *embryo* less than 25% the grain length. *Chromosome number* unknown.

Flowering and fruiting: flowering January to March; fruiting February to March.

Distribution: Australia – Australian Capital Territory, New South Wales, Victoria, Tasmania (mapped as *Poa saxicola*: Sharp and Simon 2002; Centre for Plant Biodiversity Research 2004). *Habitat*: usually in rocky alpine or subalpine meadows, herb fields and high-altitude eucalypt woodlands from 700 (in south) up to 2340 m.

Notes

Our DNA data (Gillespie *et al*. 2009) place the clade of *Hookerochloa hookeriana* and *H. eriopoda* as the sister to a clade of *Saxipoa*, *Arctagrostis*, *Sylvipoa* and *Nicoraepoa*, where *Saxipoa* is sister to *Arctagrostis* and *Sylvipoa* plus *Nicoraepoa.* *Saxipoa saxicola* differs morphologically from *Poa* in its glume and lemma margins and palea keels being densely ciliate, lemmas chartaceous, plump, and somewhat glossy, glabrous elsewhere, callus glabrous or with sparse short hairs on ventral sides, culm sheaths open to very near the base, lodicules sometimes with ciliate margins, caryopses rarely with a few short hairs at the apex, with slightly thick style bases. Unlike for the group Australopoa, the caryopsis is free from the palea. Vickery (1970) also remarked on differences of this species from other Australian *Poa*, in inflorescences with short appressed branches, spikelets broad, plump, keeled and not strongly compressed, glume and lemma margins ciliate, paleas ovate to elliptical, palea keel cilia in several rows (*v.* single rows), with the remainder of the keel smooth.

Saxipoa saxicola shares several morphological characteristics with the two *Hookerochloa* species (Jacobs *et al*. 2008), that are not shared with *Poa*, including the following: the sheath margins are fused only in the basal 1–3 mm; cilia are sometimes present also on the lodicules in *H. hookeriana*; the ligules in *Hookerochloa* species are somewhat firmly scarious, with irregular asperous to ciliolate margins; the rachillas are similarly densely pubescent in *Hookerochloa* and *Saxipoa*, a characteristic that is rare or absent in Australian *Poa*, other than in subsect. *Austrofestuca. S. saxicola* also shares the chartaceous and rather plump lemmas with *H. hookeriana*, and it sometimes has a subapical mucro, whereas the two *Hookerochloa* species are short-awned from a minute notch. *H. hookeriana* and *H. eriopoda* have stigmas that are densely plumose, up to 3 mm long, with primary branches up to 0.6 mm long, and with secondary branching, whereas *S. saxicola* has stigmas similarly shaped and densely plumose, up to 2 mm long, with primary branches 0.4 mm long and absence of secondary branching. In *P.* subsections *Australopoa* and *Austrofestuca*, stigmas are equally to slightly less dense, up to 1.8 mm long, with or without secondary branching. The leaf blades of *S. saxicola* and *H. hookeriana* are quite similar in form and vestiture. The blades are thicker than for most other Australian *Poa*, although not as indurate or pungently tipped as those in *P.* subsect. *Austrofestuca*. Lemma and glume margins and palea keels in *S. saxicola* are densely ciliate in the upper halves. The lemma margins, and to a lesser degree the glume margins, in the two species of *Hookerochloa* and some *Poa* are finely scabrous, although rarely densely so. Some *Poa* species can be softly pubescent on the lemma margins, but none is densely ciliate solely on the edge. In comparison to *Hookerochloa*, *S. saxicola* is a reduced, submesophytic alpine genus, with contracted panicles, smaller, more compact, fewer-flowered, and awnless spikelets, ciliate glume and lemma margins and palea keels, a nearly glabrous callus, and reduced stigma branching. The two *Hookerochloa* species grow in or on the margins of wetlands and in dry, stony ground in the upper forested zones of south-eastern Australian mainland and Tasmania. *H. hookeriana* sometimes grows as low as 60 m above sea level in the south, although it is more common at higher elevations up to ~1400 m, in association with drainage lines; *H. eriopoda* shows less affinity with wetlands and often grows in dry, stony ground, from ~700–1300 m. We considered whether these three species could be placed in one genus; however, apart from the obvious morphological differences,

the DNA data support *Saxipoa* as a member of a lineage of four genera that is sister to *Hookerochloa*.

Taxonomic arrangement of Australian Poa

Considering the morphological and DNA homogeneity of the Australopoa group of species, we think it is appropriate to formally describe their relationship. To indicate the likely monophyly of the following set of *Poa*, we propose to arrange *Neuropoa*, *P.* sects. *Austrofestuca* and *Brizoides*, and the Australopoa group as subsections within one section, for which the name *P.* sect. *Brizoides* has priority. We leave *P. fordeana* (Fig. 1*B*), *P. homomalla*, *P. orba* and *P. sallacustris* of Australia, and *P. keysseri* from New Guinea *incertae sedis* within *P.* sect. *Brizoides*. These changes require one new subsection, and three subsection combinations.

Poa (subg. *Poa* supersect. *Homalopoa* sect. *Brizoides*) subsect. ***Australopoa*** Soreng, L.J.Gillespie & S.W.L.Jacobs, subsect. nov. (Fig. 1*E*)

A Poarum sectione *Homalopoa* vaginis culmis connatis 8–33 (−44)% plantae Australiensis) (vel 15–60% plantae Novae Zealandiensis) non compressis neque prominenter carinatis, laminis tenuioribus plerumque convolutis vel involutis plus minusve rigidis, ad apicem acuminatis vel tenuiter naviculatis, lemmatibus nec laevibus neque glabris (sed glabris in *P. serpentum*), differt. A *Poarum* subsectione *Brizoidis* culmis ad basim sine cormis (praeter *P. crassicaudex*), ligulis brevioribus, truncata aspera vel ciliolata a ciliata (acuta et glabra in *P. hookerii*), paleis inter carinas plerumque pilis, differt. Typus: *Poa sieberiana* Spreng.

Species and distribution: **Australia**: *Poa affinis*, *P. amplexicaulis*, *P. cheelii*, *P. clelandii* Vickery, *P. clivicola* Vickery, *P. costiniana*, *P. crassicaudex*, *P. ensiformis*, *P. fawcettiae*, *P. gunnii* Vickery, *P. halmaturina* J.M.Black, *P. helmsii*, *P. hiemata*, *P. hookeri*, *P. hothamensis*, *P. induta* Vickery, *P. jugicola*, *P. labillardierei*, *P. lowanensis*, *P. meionectes*, *P. mollis* Vickery, *P. morrisii* Vickery, *P. orthoclada*, *P. petrophila* Vickery, *P. phillipsiana*, *P. physoclina* N.G.Walsh, *P. poiformis*, *P. porphyroclados*, *P. rodwayi* Vickery, *P. serpentum*, *P. sieberiana*, *P. tenera*, *P. umbricola* Vickery. **New Zealand**: *Poa anceps*, *P. chathamica*, *P. cita*, *P. cockayneana*, *P. litorosa*, *P. pusilla* Bergg. *Habitat:* alpine grasslands, subalpine and montane grasslands and woodlands, montane balds, coastal woodlands, meadows, scrubs, rocks and sands.

Poa subsect. ***Austrofestuca*** (Tzvelev) Soreng, L.J.Gillespie & S.W.L.Jacobs, stat. nov. Basionym: *Festuca* subg. *Austrofestuca* Tzvelev in Bot. Zhurn. (Moscow and Leningrad) 56: 1257 (1971). *Typus*: *Festuca littoralis* Labill. (≡ *Poa billardierei* St-Yves) (Fig. 1*G*)

Species and distribution: *Poa billardierei* (Australia and New Zealand) and *P. pubinervis* (endemic to Australia). *Habitat:* coastal sand dunes and headlands.

Poa subsect. ***Brizoides*** (Pilg. ex Potztal) Soreng, L.J.Gillespie & S.W.L.Jacobs, stat nov. Basionym *Poa* sect. *Brizoides* Pilg. ex Potztal in Willdenowia 5(3): 472 (1969). *Typus*: *Poa nodosa* Nees (= *P. drummondiana* Nees) (Fig. 1*F*)

Species and distribution: monotypic or ditypic. Australia. One species of Japan, *P. tuberifera* Faurie ex Hack., also has corm-like basal culm internodes and flaccid leaves, and sparse panicles. It is tentatively included in this subsection for the first time (previously treated *incertae sedis*), although it could be convergent in growth form. *Habitat*: dunes and margins of clay-pans in mallee-scrub and low woodlands.

Poa subsect. ***Neuropoa*** (Clayton) Soreng, L.J.Gillespie & S.W.L.Jacobs, stat. nov. Basionym *Neuropoa* Clayton in Kew Bulletin 40(4): 728 (1985). *Typus*: *Poa fax* Willis & Court

Species and distribution: monotypic. Australia. *Habitat*: in samphire swamps, margins of salt lakes or sand dunes, in sandy or saline soils (Sharp and Simon 2002).

Key to subtribe Poinae genera and groups in Australia

1. Lemma awned; panicle open, fairly loose; callus bearded or with a crown of straight, fairly stiff hairs, some up to 0.3–0.5 mm..... ..... *Hookerochloa – H. eriopoda* (Fig. 1*A*), *H. hookeriana* (Fig. 1*H*)
   Lemma unawned (rarely mucronate); panicle open and loose to tightly contracted and erect; callus glabrous or hairy, hairs, when present, concentrated in a crinkly dorsal tuft and in most taxa (web), or distributed as a crown or beard (or only under the marginal veins) and fairly straight in a few taxa....2
2. Sheath of upper culm leaf with margins joined only at the nodal band; blades 4–15 mm wide, flat, thin, lax, commonly with evident cross-veins; callus with a short (0.2 mm) crown of stiff hairs around the lemma base; lemma 2.3–3.2 mm, scaberulous throughout, glabrous, 5-veined, veins prominently raised, extending to near the apex, internerve regions membranous; panicle effuse..... *Sylvipoa – S. queenslandica*
   Sheath of upper culm leaf with margins fused ≥1 mm or more above the nodal band; blades mostly <5 mm wide, flat or more often-folded and/or inrolled, thin to thick, lax to rigid, without evident cross-veins; callus glabrous or variously pubescent, but not with a short (0.2 mm), stiff crown of hairs around the lemma base; lemma 1.8–14.5 mm, smooth or scaberulous, glabrous or pubescent, 5–11-veined, veins not prominently raised, usually not extending to near apex, internerve regions membranous to chartaceous; panicle contracted to effuse.....3
3. Plant annual.....4
   Plant perennial.....5
4. Lemma 5-nerved, membranous; panicle loosely contracted to open; anthers 0.2–1 mm; culm internodes glabrous; palea keels softly pubescent, smooth throughout.....**P.* subg. *Ochlopoa* sect. *Micrantherae – P. annua* L., *P. infirma* Kunth.
   Lemma 7–11-nerved, chartaceous; panicle contracted, linear; anthers 1.6–3 mm; culm internodes sometimes pubescent; palea keels scabrous at least towards the apex..... *P.* subsect. *Neuropoa – P. fax*
5. Panicle tightly contracted, linear to lanceolate, branches appressed; lemmas firmly membranous to chartaceous.....6
   Panicle loosely contracted to wide open, branches ascending to spreading or reflexed; lemmas membranous to somewhat firmly membranous, rarely subchartaceous.....8

6. Uppermost culm sheath margins fused 1–3% of the length; lemma and glume outer margins densely ciliate (hairs in the same plane as the lemma surface), glabrous elsewhere; lemma up to 3.8–5.5 mm, chartaceous; palea keels densely ciliate, cilia in more than one file, sulcus glabrous; callus glabrous or with one to several short hairs below the lateral edges of the lemma..... *Saxipoa* – *S. saxicola*
   Uppermost culm sheath margins fused 25–35% of the length; lemma and glume outer margins smooth to scaberulous or, if somewhat ciliate, then lemma pubescent elsewhere; lemma 5.5–14.5 mm, firmly membranous to chartaceous, or 2.8–6 mm, membranous to somewhat firmly membranous (*P. poiformis*); palea keels scabrous, sometimes softly pubescent for part of the length, soft hairs (if present) more or less in a single file, sulcus glabrous or pubescent; callus glabrous or variously pubescent, but not with only one to several short hairs below the lateral edges of the lemma.....7
7. Lemma (5.5–)8.5–12.8(–14.5) mm, firmly membranous to subchartaceous, with or without a brief mucro; callus with a beard of hairs (hairs sometimes scant, infrequently absent); caryopsis broad-shouldered, hilum 1 mm..... *P.* subsect. *Austrofestuca* – *P. billardierei*, *P. pubinervis*
   Lemma mostly 2.8–6 mm, membranous to somewhat firmly membranous, without a mucro; callus with a web; caryopsis narrow-shouldered, hilum 0.2–0.3(–0.5) mm..... *P.* subsect. *Australopoa* – *P. poiformis*
8. New shoots with bulb-like bases..... **P.* subg. *Ochlopoa* sect. *Arenariae* (syn. sect. *Bolbophorum* Asch. & Graebn.) – *P. bulbosa* L.
   New shoots or culms without bulblike bases, sometimes with corm-like swellings.....9
9. Basal 1-several culm internodes with well developed corm-like swellings; lemma pubescent in the margins (from the marginal nerve to the edge) only or also on the keel; florets spreading at maturity..... *P.* subsect. *Brizoides* – *P. drummondiana*
   Basal culm internodes without corm-like swellings (lowest internode sometimes swollen in *P. crassicaudex* and a few other species); lemma, if pubescent, with hairs not confined to the margins; florets ascending at maturity.....10
10. Culm uppermost sheaths closed (48–)50–90% of the length; uppermost ligules 1.5–7 mm, apices smooth, glabrous; blades flat or folded, soft, 1.5–5 mm wide; plants rhizomatous; vegetative shoots all or predominantly extravaginal; callus hairs, if present, not in a well defined dorsal tuft.....11
    Culm uppermost sheaths closed 8–50% of the length; ligules mostly <3 mm (except *P. hookeri*, *P. trivialis* L.), apices often scaberulous, ciliolate or ciliate; blades flat to involute, soft to moderately firm, 0.5–5 mm wide; plants without rhizomes or, if rhizomatous, then not with smooth and glabrous margins; vegetative shoots intra- or extravaginal or both; callus hairs, if present, in a well defined dorsal tuft.....13
11. Rhizomes without swollen internodes; uppermost ligules up to 2–7 mm; callus glabrous..... *P.* sect. *Brizoides* (*incertae sedis*) – *P. homomalla*
    Rhizomes with slightly swollen internodes; callus usually hairy.....12
12. Leaf blades 0.5–2 mm wide, folded; uppermost ligules 1–3.5 mm; vegetative shoots mostly clustered..... *P.* sect. *Brizoides* (*incertae sedis*) – *P. sallacustris*
    Leaf blades 1.5–5 mm wide, flat or folded; lemmas densely silky pubescent along the keel and lateral nerves and usually between the nerves; vegetative shoots mostly solitary or few together..... *P.* sect. *Brizoides* (*incertae sedis*) – *P. fordeana*
13. Culm and nodes conspicuously compressed, lower culm nodes exposed; plants strongly rhizomatous with isolated culms and shoots..... **P.* subg. *Stenopoa* sect. *Tichopoa* – *P. compressa* L.
    Culm and nodes not conspicuously compressed, lower culm nodes mostly enclosed in sheaths; plants with or without rhizomes, with isolated culms or more commonly with culms from within basal tufts.....14
14. Ligule apex acute or acuminate, glabrous, those of uppermost culm leaves 2–10 mm, thinly scarious..... 15
    Ligule apex truncate to obtuse, often ciliolate or ciliate, those of uppermost culm leaves 0.2–3 mm, thinly to thickly scarious.....16
15. Blades 1–6 mm wide, flat; first glume 1-nerved, often sickle-shaped..... **P.* subg. *Stenopoa* sect. *Pandemos* – *P. trivialis*
    Blades <1mm wide, capillary, involute; first glume 1–3-nerved, not sickle-shaped..... *P.* subsect. *Australopoa* – *P. hookeri*
16. Plant strongly and extensively rhizomatous; upper culm sheaths open ~30–50% of the length; callus with a copious web; lemma distinctly pubescent on the keel and marginal veins only; upper culm leaf ligule 1–2(–3) mm, with apex truncate to slightly rounded, entire, obscurely ciliolate (×25 or higher magnification); palea keels scabrous, glabrous, between keels smooth or sparsely scaberulous, glabrous..... .....**P.* subg. *Poa* supersect. *Poa* sect. *Poa* – *P. pratensis* L.
    Plant either without strong and extensive rhizomes, or with sheaths more open; or with a sparse or absent web, or with a different ligule form, or with paleas pubescent for some portion of the keel or between the keels. 17
17. Lemma glabrous; callus glabrous; plant strongly laterally spreading rhizomatous; ligule apex smooth, glabrous ....*Poa* sect. *Brizoides* (*incertae sedis*) – *P. orba*
    Lemma usually pubescent; callus (usually of at least a few florets) with at least a few isolated dorsal hairs (web); plant tufted without lateral shoots, or with short lateral rhizomes or stooling, or with branching from mid- to upper culm nodes, but not with strongly laterally spreading elongated rhizomes; ligule apex usually asperous, ciliolate or ciliate..... *P.* subsect. *Australopoa* – (see species list above)

Notes

All native Australian *Poa*, are placed in *P.* subg. *Poa*. supersect. *Homalopoa* sect. *Brizoides*, and all but (*incertae sedis*) *P. fordeana*, *P. homomalla*, *P. orba* and *P. sallacustris* are placed within subsections. Introduced (*) species belong to *P.* subg. *Ochlopoa* (Asch. & Graebn.) Hyl. sects. *Arenariae* Stapf and *Micrantherae* Stapf (syn. sect. *Ochlopoa* Asch. & Graebn.), *P.* subg. *Poa* sects. *Dioicopoa* E.Desv. and *Poa*, *P.* subg. *Stenopoa* (Dumort.) Soreng & Gillespie sects. *Pandemos* Asch. & Graebn., *Secundae* V.L.Marsh ex Soreng, *Stenopoa* Dumort. and *Tichopoa* Asch. & Graebn. *P. arachnifera* Torrey (sect. *Dioicopoa*), *P. nemoralis* L. (sect. *Stenopoa*) and *P. secunda* J.Presl (syn. *P. nevadensis* Vasey ex Scribn.) (sect. *Secundae*), which are not thought to have established outside of experimental gardens (Vickery 1970; Sharp and Simon 2002), are excluded from the key.

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References

Alexeev EB (1976) *Austrofestuca* (Tzvel.) E.Alexeev comb. nov. a new genus of the family Poaceae from Australia. *Byulleten Moskovskogo Obshchestva Ispyteley Prirody Biologia* **81**, 55–60.

Alexeev EB (1985) New genera of grasses. *Byulleten Moskovskogo Obshchestva Ispyteley Prirody Biologia* **90**, 102–109.

Alexeev EB (1987) *Festuca* L. et genera proxima (Poaceae) in Australia et Tasmania. *Novitates Systematicae Plantarum Vascularum* **24**, 5–17.

Bor NL (1952*a*) The genus *Poa* Linn. in India. Part I. *Journal of the Bombay Natural Historia y Sociedad (Rio Piedras, San Juan, P.R.)* **50**(4), 1–838.

Bor NL (1952*b*) The genus *Poa* Linn. in India. Part II. *Journal of the Bombay Natural Historia y Sociedad (Rio Piedras, San Juan, P.R.)* **51**(1), 53–103.

Bor NL (1960) 'The grasses of Burma, Ceylon, India and Pakistan.' (Pergamon Press: Oxford, UK)

Bor NL (1968) Gramineae. In 'Fl. Iraq. Vol. 9'. (Ministry of Agriculture: Baghdad)

Bor NL (1970) Gramineae. In 'Fl. Iranica. Vol. 70/30'. (Akademische Druck: Graz, Austria)

Centre for Plant Biodiversity Research (2004) 'Australia's virtual herbarium.' [Map output.] (Eds Council of Heads of Australian Herbaria). Available at http://www.cpbr.gov.au/cgi-bin/avh.cgi [verified March 2009].

Clayton WD (1985) Miscellaneous notes on pooid grasses. *Kew Bulletin* **40**, 727–729. doi: 10.2307/4109854

Clayton WD, Renvoize SA (1986) 'Genera graminum – grasses of the world.' Kew Bulletin Additional Series XIII. (Her Majesty's Stationery Office: London)

Davidse G, Soreng RJ, Peterson PM (2009) *Agrostopoa* (Poaceae: Pooideae: Poeae: Poinae), a new genus with three species from Colombia. *Novon* **19**, 32–40.

Edgar E (1986) *Poa* L. in New Zealand. *New Zealand Journal of Botany* **24**, 425–503.

Edgar E, Connor HE (2000) 'Flora of New Zealand. Vol. V. Gramineae.' (Manaaki Whenua Press: Lincoln, New Zealand)

Edmondson JR (1980) *Poa* L. In 'Flora Europaea. Vol. 5'. (Eds TG Tutin, VH Heywood, NA Burges, DM Moore, DH Valentine, SM Walters, DA Webb) pp. 159−167. (Cambridge University Press: Cambridge, UK)

Edmondson JR (1985) *Poa* L. In 'Flora of Turkey and the East Aegean Islands. Vol. 9'. (Ed. PH Davis) pp. 470−485. (University Press: Edinburgh)

Gillespie LJ, Soreng RJ (2005) A phylogenetic analysis of the bluegrass genus *Poa* L. (Poaceae) based on plastid DNA restriction site data. *Systematic Botany* **30**, 84–105. doi: 10.1600/0363644053661940

Gillespie LJ, Archambault A, Soreng RJ (2007) Phylogeny of *Poa* (Poaceae) based on *trn*T–*trn*F sequence data: major clades and basal relationships. In 'Proceedings of the fourth international conference on grass systematics and evolution'. *Aliso* **23**, 420–434.

Gillespie LJ, Soreng RJ, Bull R, Jacobs SWL, Refulio-Rodriguez NF (2008) Phylogenetic relationships in subtribe Poinae (Poaceae, Poeae) based on nuclear ITS and chloroplast *trn*T–*trn*F sequences. *Botany* **86**, 938–967. doi: 10.1139/B08-076

Gillespie LJ, Soreng RJ, Jacobs SWL (2009) Phylogenetic relationships of Australian *Poa* (Poaceae: Poinae): molecular evidence for two new genera, *Saxipoa* and *Sylvipoa*. *Australian Systematic Botany* **22**, 413–436. doi: 10.1071/SB09016

Gillespie LJ, Soreng RJ, Paradis LM, Bull RD (in press) Phylogeny and reticulation in Poinae subtribal complex based on nrITS, ETS, and trnTLF data. In 'Proceedings of the fourth international conference on the comparative biology of the monocotyledons, the fifth international symposium on grass systematics and , Copenhagen 2008'. (Eds O Seberg, JI Davis) (Aarhus University Press: Aarhus, Denmark)

Hooker JD (1860) 'The botany of the Antarctic voyage III. Flora Tasmaniae.' Pl. CLXIV. (Reeve Brothers: London)

Hunter AM, Orlovich DA, Lloyd KM, Lee WG, Murphy DJ (2004) The generic position of *Austrofestuca littoralis* and the reinstatement of *Hookerochloa* and *Festucella* (Poaceae) based on evidence from nuclear (ITS) and chloroplast (*trn*L–*trn*F) DNA sequences. *New Zealand Journal of Botany* **42**, 253–262.

Jacobs SWL (1990) Notes on Australian grasses (Poaceae). *Telopea* **3**, 601–603.

Jacobs SWL, Hastings SM (1983) *Poa* L. In 'Flora of New South Wales, Vol. 4'. (Ed. GJ Harden) pp. 619–628. (New South Wales University Press: Sydney)

Jacobs SWL, Gillespie LJ, Soreng RJ (2008) New combinations in *Hookerochloa* and *Poa* (Gramineae). *Telopea* **12**, 273–278.

Morris DI (1989) New taxa and a new combination in Tasmanian Poaceae. *Muelleria* **7**, 147–171.

Rajbhandari KR (1991) A revision of the genus *Poa* L. (Gramineae) in the Himalaya. *Bulletin of the University Museum, University of Tokyo* **34**, 169–249.

Sharp D, Simon BK (2002) 'AusGrass: grasses of Australia. Version 1.0, July 2002.' [CD.] (Australian Biological Resources Study: Canberra; Environment Protection Agency: Brisbane)

Soreng RJ (1990) Chloroplast-DNA phylogenetics and biogeography in a reticulating group: study in *Poa*. *American Journal of Botany* **77**, 1383–1400. doi: 10.2307/2444749

Soreng RJ (2007) *Poa* L. In 'Magnoliophyta: Commelinideae (in part); Poaceae, part 1. Flora of North America North of Mexico. Vol. 24'. (Eds ME Barkworth, KM Capels, SL Long, LK Anderton, MB Piep) pp. 486−601. (Oxford University Press: New York)

Soreng RJ, Gillespie LJ (2007) *Nicoraepoa* (Poaceae, Poeae), a new South American genus based on *Poa* subgenus *Andinae*, and emendation of *Poa* section *Parodiochloa* of the sub-antarctic islands. *Annals of the Missouri Botanical Garden* **94**, 821–849. doi: 10.3417/0026-6493(2007)94[821:NPPANS]2.0.CO;2

Soreng RJ, Giussani LM, Negritto M (2003) *Poa* L. In 'Catalogue of New World grasses (Poaceae): IV. Subfamily Pooideae'. (Eds RJ Soreng, PM Peterson, G Davidse, EJ Judziewicz, FO Zuloaga, TS Filgueiras, O Morrone) pp. 505−580. *Contributions from the United States National Herbarium* **48**, 1–730.

Soreng RJ, Davis JI, Voionmaa MA (2007) A phylogenetic analysis of Poaceae tribe Poeae *s.lat.* based on morphological characters and sequence data from three chloroplast-encoded genes: evidence for reticulation, and a new classification for the tribe. *Kew Bulletin* **62**, 425–454.

Soreng RJ, Bull RD, Gillespie LJ (in press) Phylogeny and reticulation in *Poa* L. based on plastid trnTLF and nrITS sequences with attention to diploids. In 'Proceedings of the fourth international conference on the comparative biology of the monocotyledons, the fifth international symposium on grass systematics and, Copenhagen (2008)'. (Eds O Seberg, JI Davis) (Aarhus University Press: Aarhus, Denmark)

Tzvelev NN (1976) 'Zlaki SSSR.' (Nauka Publishers: Leningrad) [English translation (1983): Grasses of the Soviet Union. Vols 1 and 2. (Amerind Publishing Co.: New Delhi)]

Veldkamp JE (1994) *Poa* L. (Gramineae) in Malesia. *Blumea* **38**, 409–457.

Vickery JW (1970) A taxonomic study of the genus *Poa* L. in Australia. *Contributions from the New South Wales National Herbarium* **4**, 145–243.

Walsh NG (1991) New taxa in Victorian Poaceae. *Muelleria* **7**, 379–387.

Walsh NG (2008) A new species of *Poa* (Poaceae) from the Victorian Basalt Plain. *Muelleria* **26**, 17–20.

Walsh NG, Weiller CM, Thompson IR (2009) *Poa* L. In 'Flora of Australia Vol. 44A, Poaceae 2'. (Eds Flora Australia Committee) pp. 301–338. (ABRS/CSIRO Australia: Melbourne)

Weiller CM, Henwood MJ, Lenz J, Watson L (1995 onwards) 'Pooideae (Poaceae) in Australia.' Delta database. Available at http://delta-intkey.com/pooid/www/index.htm [verified 2009].

Weiller CM, Stajsic V, Walsh NG (2005) New Victorian endemic species of *Poa* L. (Poaceae). *Muelleria* **22**, 11–17.

Zhu G-H, Lui L, Soreng RJ, Olonova MV (2006) *Poa* L. In 'Flora of China. Vol. 22, Poaceae'. (Eds Flora of China Editorial Committee) pp. 257−309. (Missouri Botanical Garden Press: Saint Louis, MI)

Zuloaga FO, Morrone O, Belgrano MJ (Eds) (2008) 'Catálogo de las plantas vasculares del cono sur (Argentina, Sur de Brasil, Chile, Paraguay y Uruguay). Vol. 1, Pteridophyta, Gymnospermae y Monocotyledoneae.' (Missouri Botanical Garden Press: Saint Louis, MI)

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