Phylogeny and taxonomic synopsis of *Poa* subgenus *Pseudopoa* (including *Eremopoa* and *Lindbergella*)

(Poaceae, Poeae, Poinae)

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Abstract

*Eremopoa* is a small genus of annual grasses distributed from Egypt to western China. Phylogenetic analyses of plastid and nuclear ribosomal DNA show that *Eremopoa* species, together with the monotypic genus *Lindbergella* and a single species of *Poa* (*P. speluncarum*), are nested within the genus *Poa*, in a clade that we accept as *Poa* subg. *Pseudopoa*. Here we accept seven species, four subspecies and four varieties in *Poa* subg. *Pseudopoa*. Five new combinations are made: *Poa attalica*, *P. diaphora* var. *alpina*, *P. diaphora* var. *songarica*, *P. nephelochloides* and *P. persica* subsp. *multiradiata*; *P. millii* is proposed as a replacement name for *E. capillaris*; and *Poa* sections *Lindbergella* and *Speluncarae* are proposed. We provide a diagnosis for *Poa* subg. *Pseudopoa*, synonymy for and a key to the taxa. Eight lectotypes are designated: *Eragrostis barbeyi* Post, *Eremopoa nephelochloides* Roshev., *Glyceria taurica* Steud., *Nephelochloa tripolitana* Boiss. & Blanche, *Poa cilicensis* Hance, *Poa paradoxa* Kar. & Kir., *Poa persica* var. *alpina* Boiss and *Poa persica* subsp. *cypria* Sam. *Eremopoa medica* is re-identified as a species of *Puccinellia*.

Keywords

Annuals, classification, DNA, *Eremopoa*, grasses, *Lindbergella*, phylogeny, *Poa*, Poaceae, taxonomy
Introduction

_Eremopoa_ Roshev. is a small, primarily west and central Asian genus of annual grasses. Roshevitz (1934) named the genus _Eremopoa_ (Greek: _eremos_ = desert, _poa_ = fodder / > bluegrass) and included six species of annuals for the former U.S.S.R. Up to that time, one or more of the taxa had been described or treated in _Aira_ L. (Trinius 1835), _Eragrostis_ Wolf (Post and Autran 1897), _Festuca_ L. (Koch 1848), _Glyceria_ R. Br. (Fischer and Meyer 1841, Steudel 1854), _Nephelechloa_ Boiss. (Grisebach 1852, Boissier and Blanche 1859) and _Poa_ L. (Trinius 1830, 1836, Steudel 1854, Boissier 1884, Hackel 1887, Stapf 1897, Ascherson and Graebner 1900). _Poa persica_ Trin. is the type species of _Eremopoa, Festuca_ sect. _Pseudopoa_ K. Koch, _Poa_ subgen. _Pseudopoa_ (K. Koch) Stapf and _P._ sect. _Pseudopoa_ (K. Koch) Hack. After _Eremopoa_ was described, most authors accepted the genus (Grossheim 1939, Köie 1945, Bor 1960, 1968a, 1970, Pavlov and Gamajunova 1964, Tzvelev 1966, 1976, 1989, Scholz 1980, 1981, Tutin 1980, Czerepanov 1981, 1995, Cope 1982, Mill 1985, Clayton and Renvoize 1986, Watson and Dallwitz 1992, Soreng 2003, Valdés and Scholz 2006, Darbyshire 2007, Cabi and Doğan 2012, Nikiforova et al. 2012). Few taxonomists continued to refer the species to _Poa_ (Samuelsson 1950, Kovalevskaja 1968). No revision of the genus as a whole exists.

Roshevitz (1934) differentiated the genus _Eremopoa_ from _Poa_ as: always annuals with long panicle branches arranged in half-whorls; glumes unequal, inferior 1-veined, superior 3-veined; lemmas with obscure keel and lateral veins, apex acuminate or briefly aristate; and callus without lanate hairs. Tzvelev (1976) added the following characteristics: lower glumes 2/7–2/3 the first lemma in length; lemmas somewhat keeled with 5 veins, apex gradually tapering, sometimes with a short cusp, somewhat scabrous due to very short spinules and often pilose in the lower part along the keel and marginal veins; callus obtuse, glabrous or almost glabrous; leaf sheaths closed only at the base and leaf blades flat or loosely folded. The genus is relatively easy to recognise as a set of annuals, whereas _Poa_ has few annuals and those are distinct from species included in _Eremopoa_. However, none of the characters by themselves actually differentiates _Eremopoa_ from _Poa_. In _Poa_, glumes can also be short, the lower one is commonly 1-veined, the upper one normally 3-veined. Lemmas in _Poa_ are usually distinctly keeled, with soft hairs at least on the keel and with an obtuse, acute or acuminate apex. They are rarely weakly keeled (e.g. in sect. _Secundae_), sometimes glabrous (ca. 15% of spp.) and rarely produce a minute cusp (a cusp occurs more often than acknowledged in the literature, but is usually irregularly expressed). In _Poa_, a dorsal tuft of hairs on the callus is present in 2/3 of the species. In the other species, the callus is sometimes glabrous or has a minute or more developed crown of hairs around the base of the lemma. In addition, _Poa_ leaf sheaths are only infrequently closed at the base, most being closed more than 1/10 the length, and leaf blade form runs the gamut from flat and thin to tough and involute. Panicle branches in _Poa_ are infrequently whorled with 6 or up to 9 branches per lower node, the normal range is 1 to 5. Although panicle branches are commonly numerous (ranging up to 27) in _Eremopoa_, with most taxa usually having over 5, _E. altaica_ (Trin.) Roshev. has 1–5(–7) and _E. songarica_ (Schrenk ex Fisch. & C.A. Mey.) Roshev. varies widely with (1–)3–8(–12).
Eremopoa species are annual with some extreme features usually not found in Poa, but, other than abundantly branching panicles, those characteristics are broached in all cases. No one has doubted that Eremopoa was closely related to Poa.

The taxa placed in Eremopoa range from Egypt (Sinai and north coast) across the northern Middle East (Israel, Lebanon, Syria, Iraq, Turkey [Anatolia], Iran), to Afghanistan, Pakistan, northwest India (Himachal Pradesh, Kashmir), western China (Tibet and Xinjiang), north through Transcaucasia into the Caucasus mountains of Russia and across central Asia in Turkmenistan, Uzbekistan, Tajikistan, Kyrgyz Republic and Kazakhstan. Two taxa have been observed elsewhere as waifs: E. persica in western Europe (France, Norway) and E. altaica (Trin.) Roshev. in Canada (see references in Taxonomy section). The geographic region with the most diversity of Eremopoa taxa is clearly Asia Minor; nearly all of the accepted species occur in Turkey.

There have been many differences of opinion on the species and infraspecific ranks to accept in Eremopoa (Table 1). Roshevitz (1934) treated six species in his new genus in the former U.S.S.R (E. altaica, E. bellula (Regel) Roshev., E. oxyglumis (Boiss.) Roshev., E. multiradiata (Traurtv.) Roshev., E. persica and E. songarica). Tzvelev (1976) reduced these six species to two species, E. persica and E. altaica, with two and three subspecies, respectively, all of which were accepted as species by Czerepanov (1981, 1995). Scholz (1980, 1981) described two new species, E. attalica H. Scholz from Turkey and E. medica H. Scholz from Azerbaijan. The type of E. medica (holotype at W, isotype at B) was determined to be a species of Puccinellia Parl. (Soreng pers. obs. 2015). Mill (1985) treated six species in Turkey, including two new species, E. capillaris R.R. Mill and E. mardinensis R.R. Mill. Rahmanian et al. (2014) accepted four species in Iran, including E. medica and E. persica with three varieties.

Bor’s genus Lindbergella (Bor 1968b, 1969) comprises a single annual species that is morphologically similar to Eremopoa. It differs from Eremopoa only in having firmer lemmas that are 3-veined and obscurely apiculate and panicles with 1–5 branches that are smooth. Lindbergella sintenisii (H. Lindb.) Bor was originally published as Poa sintenisii by Lindberg (1942) and also as P. persica var. cypria by Samuelsson (1950), the type of which is a syntype of P. persica var. alpina Boissier (1884). The species is endemic to Cyprus.

The first molecular data on Eremopoa, generated by our lab in 2004/2005, indicated that E. songarica was nested within Poa. That data was first published by Gillespie et al. (2007) using chloroplast DNA sequences from the trnT-trnL-trnF region. Based on this same data, inclusion of Eremopoa in Poa was already applied in the Flora of China account (Zhu et al. 2006, as P. subg. Pseudopoa (K. Koch) Stapf) and was continued in Gillespie et al. (2008, 2010), Soreng (2004+) and Soreng et al. (2010, 2015a, 2017a). Although nested within Poa, Eremopoa was positioned on a long branch separate from other Poa clades, justifying its recognition as a distinct subgenus, P. subg. Pseudopoa (Gillespie et al. 2007).

We published our initial DNA results for only one species of Eremopoa (E. songarica) based on trnT-trnL-trnF and, subsequently, nuclear ribosomal (nrDNA) ITS and ETS sequence data (Gillespie et al. 2007, 2008, 2010, Soreng et al. 2010). We subsequently sequenced two additional plastid regions (matK and rpoB-trnC) and added
### Table 1. Classification history of *Eremopoa* and other taxa here accepted in *Poa* subg. *Pseudopoa*. Species and infraspecific taxa accepted by Roshevitz (1934) and authors of major floras and the region covered by their treatments are given. The last column provides the corresponding names in *Poa* accepted here.

| Roshevits (1934) | Roshevits (in Köie 1945) | Bor (1970) | Tzvelev (1976, 1983) | Cope (1982) | Mill (1985) | Czerepanov (1995) | Zhu et al. (2006) | Gabrieljan and Oganesian (2010) | Rhamanian et al. (2014) | Euro+Med (online) | Here |
|------------------|--------------------------|----------|---------------------|-----------|-----------|-------------|-------------|----------------|-------------------|----------------|-------|
| USSR             | SW Iran                  | Iran, Afghanistan, w. Pakistan, n. w. Iraq, s. Turkmenistan, s.e. Azerbaijan | USSR | Pakistan | Turkey | USSR | China (Xinjiang, Xizang) | Armenia | Iran | Europe, Transcaucasia, Turkey, Levant, North Africa | whole range |
| *E. persica*     | *E. persica*              | *E. persica* | *E. persica*       | *E. persica* | *E. persica* | *E. persica* | *E. persica* | *E. persica* | *E. persica* | *E. persica* | *Poa persica* |
| –                | –                        | var. *persica* | subsp. *persica* | –         | –         | –            | var. *persica* | –            | –                | –              |
| –                | var. major               | –         | –                   | –         | –         | –            | –            | –            | –                | –              |
| *E. multiradiata*| –                        | (= var. *songarica*) | subsp. *multiradiata* | subsp. *multiradiata* | *E. multiradiata* | *E. multiradiata* | (= *persica* var. *persica*) | *E. multiradiata* | subsp. *multiradiata* |
| *E. altaica*     | –                        | –         | *E. altaica* | *E. altaica* | –         | *E. altaica* | *P. diaphora* | –            | –                | *E. altaica* | *P. diaphora* |
| –                | –                        | subsp. *altaica* | subsp. *altaica* | –         | –         | subsp. *diaphora* | –            | subsp. *altaica* | –                | subsp. *diaphora* |
| –                | var. *songarica*         | –         | subsp. *songarica* | subsp. *songarica* | *E. songarica* | *E. songarica* | var. *songarica* | subsp. *songarica* | var. *songarica* |
| *E. songarica*   | –                        | var. *songarica* | subsp. *songarica* | subsp. *songarica* | *E. songarica* | *E. songarica* | var. *songarica* | subsp. *songarica* | var. *songarica* |
| *E. bellula*     | –                        | *E. bellula* (pp. = *altaica*, pp = *songarica* (= *altaica* s.l.)) | (indirectly referenced, not accepted) | (pp. = *altaica*, pp = *songarica*) | –         | –         | –            | –            | –                | var. *alpina* |
| *P. persica* var. *alpina* (under *oxyglumis*) | – | – | – | – | – | – | – | – | – | var. *alpina* |
| *E. oxyglumis*   | *E. oxyglumis* (= var. *songarica*) | subsp. *oxyglumis* | subsp. *oxyglumis* | (= *E. songarica*) | E. *oxyglumis* | subsp. *oxyglumis* | E. *oxyglumis* | subsp. *oxyglumis* | subsp. *oxyglumis* | subsp. *oxyglumis* |
| –                | –                        | –         | –                   | –         | –         | –            | E. *attaica* | –            | –                | *P. attalica* |
| –                | –                        | –         | –                   | –         | –         | –            | E. *capillaris* | –            | –                | *P. millii* |
| –                | –                        | –         | –                   | –         | –         | –            | E. *capillaris* | –            | –                | *P. millii* |
| –                | –                        | –         | E. *mardinensis*   | –         | –         | –            | E. *mardinensis* | (= *P. persica* subsp. *multiradiata*) | –                | *P. nepheleoboides* |
| –                | *E. nephelochloides*     | –         | –                   | –         | –         | –            | *E. nephelochloides* (Iran) | –            | –                | *P. sintenisii* |
| –                | –                        | –         | –                   | –         | –         | –            | –            | –            | –                | *P. spelumcarum* |
data for *Eremopoa persica* (Cabi et al. 2017, as *Poa persica*). A DNA analysis of ITS sequence data by Hoffmann et al. (2013) showed *Lindbergella sintenisii* was also nested within *Poa* near *Eremopoa*. Since then, we have accumulated nrDNA and plastid sequence data for most of the *Eremopoa* taxa and *L. sintenisii* and sampled many more species of *Poa* from Turkey and around the world. Analysis of our accumulated phylogenetic data on *Eremopoa* is presented here. All *Eremopoa* taxa were nested well within *Poa*, and *P. speluncarum* J.R. Edm. and *L. sintenisii* were found to be nested within or sister to the set of *Eremopoa* species. Here we place these taxa in *Poa* subg. *Pseudopoa* and present a taxonomic synopsis of all the species and infraspecies, as well as a key to the taxa we currently accept. Further study is needed before a comprehensive revision of the subgenus can be produced.

**Methods**

Collections of *Eremopoa* at E and G (except those not available for loan), several from P and two type specimens from BM and B were loaned to RJS at US. Other material was examined by RJS at B, K, LE, P, US and herbaria in Turkey (ANK, ISTE, NKU). Fieldwork in which 38 specimens of *Eremopoa* were collected by us was conducted in Kyrgyz Republic (RJS 2006) and Turkey (RJS and associates 1994, 2013, 2014, 2015; LJG & RJS and associates 2011; EC was a co-collector on the 2011 to 2015 expeditions). Additional material was obtained from R. Hand (*Lindbergella sintenisii*) and M. Assadi and M. Amini-Rad (Iranian *Eremopoa*).

The molecular phylogenetic analysis included 77 samples: 15 *Eremopoa*, 56 *Poa*, 1 *Lindbergella* and 5 outgroup samples (Appendix 1). A diverse set of *Poa* species was chosen to represent the majority of sections, including all sections in southwest Asia. Outgroup taxa were chosen to include representatives of the two taxa (*Phleum* L. and *Milium* L.) and one clade considered most closely related to *Poa* (Gillespie et al. 2010, Soreng et al. 2015b). Sequences of *Lindbergella* and the majority of *Eremopoa* samples, plus many *matK* and *rpoB* sequences, are new to this study (Appendix 1). For simplicity, due to the confusing taxonomy and nomenclature, we refer to *Eremopoa* taxa using names at the species level in the Results, trees and Appendix 1 (see Table 1 for their corresponding names in *Poa*). The collection TARI 135082 was previously identified as *E. medica* (Rahmanian et al. 2014), but was re-determined by RJS as *P. persica* subsp. *persica*.

DNA was extracted from silica gel dried or herbarium leaf material as described in Gillespie et al. (2008). Three plastid markers (*matK, rpoB-trnC* and *trnT-trnL-trnF* [TLF]) and two nuclear ribosomal DNA (nrDNA) markers (internal transcribed spacer [ITS] and external transcribed spacer [ETS]) were sequenced. Amplification and sequencing protocols, including primers used, were described in our previous studies, as follows: ITS and TLF (Gillespie et al. 2008); ETS (Gillespie et al. 2009, 2010); *matK* and *rpoB-trnC* (Soreng et al. 2015b). Sequences were assembled, edited, aligned and concatenated using Geneious ver. 6.1.5 (http://www.geneious.com). The MAFFT ver. 7.017 plugin (Katoh and Standley 2013) was used for alignment, followed by manual
adjustment. All samples are complete for all markers, except for several samples with missing ends. The molecular study was conducted at the Canadian Museum of Nature; sequencing was mostly performed by NA, analyses by LJG.

Maximum parsimony (MP) analyses were performed in PAUP* 4.0b10 (Swofford 2002) using the heuristic search command with default settings, including tree bisection-reconnection (TBR) swapping, saving all multiple shortest trees (Multrees) with a maximum number set to 100,000. Branch support was assessed using MP bootstrap analyses performed in PAUP* with heuristic search strategy, 10,000 bootstrap replicates, each with ten random addition sequence replicates, saving ten trees per replicate.

Bayesian Markov chain Monte Carlo analyses were conducted in MrBayes (Ronquist et al. 2011). Optimal models of molecular evolution for individual markers were first determined using the Akaike information criterion (AIC; Akaike 1974) conducted through likelihood searches in jModeltest with default settings (Darriba et al. 2012). Models were set at GTR + Γ for ITS, ETS and rpoB-trnC partitions and GTR + I + Γ for matK and TLF partitions based on the AIC scores and the models allowed in MrBayes. Two independent runs of four chained searches were performed for either two or three million generations (analyses were stopped when split frequency of 0.005 was reached or closely approached), sampling every 500 generations, with default parameters. A 25% burn-in was implemented prior to summarising a 50% majority rule consensus tree and calculating Bayesian posterior probabilities (pp).

MP heuristic searches and bootstrap analyses were performed initially on the separate marker alignments. Strict consensus trees were examined for conflicting topologies with incongruence identified by branch conflicts with ≥75% bootstrap support (BS). No supported incongruence was found between ITS and ETS trees, nor amongst the three plastid trees. Further MP and Bayesian analyses were performed on the separate concatenated nrDNA (77 samples, 1251 aligned characters) and plastid (77 samples, 4465 characters) alignments. Since supported incongruence was detected between the nrDNA and plastid strict consensus trees, species and clades determined to be incongruent were removed prior to performing analyses on the concatenated combined nrDNA and plastid alignment (68 samples, 5599 aligned characters). Trees were viewed in FigTree v1.4.0 (Rambaut 2006+). Clade designations follow Soreng et al. (2010) with modifications as in Cabi et al. (2017) and Soreng et al. (2017b), wherein well-supported major clades are assigned letters.

Results

Plastid and nrDNA Bayesian trees are given in Fig. 1 with summary statistics in Suppl. material 1. There are 100 new sequences reported in GenBank and these are given in Appendix 1. MP trees (bootstrap values shown below branches in Fig. 1) were very similar to the Bayesian trees with a few minor unsupported differences. Major clades (shown by letter and colour in Fig. 1) are identical in both nrDNA and plastid trees,
with two exceptions: *Poa arctica* R. Br. and *P. sect. Secundae* members (*P. curtifolia* Scribn., *P. secunda* J. Presl and *P. stenantha* Trin.), each belonging to different major clades in the two trees. The position of three major clades differs significantly between the nrDNA and plastid trees: *J* clade (sect. *Jubatae: P. jubata* A. Kern.), *S* clade (sects. *Stenopoa* and *Abbreviatae*) and *V* clade (sect. *Pandemos: P. trivialis* L.). *Poa* major clades have been described elsewhere (Gillespie et al. 2007, 2008, 2009, Soreng et al. 2010, 2017b, Cabi et al. 2017); here we focus on the position of *Eremopoa*.

*Eremopoa* species, together with *Lindbergella sintenisii* and *Poa speluncarum*, form a clade (*E* clade) in both nrDNA and plastid trees, but are strongly supported only in the plastid analysis (pp = 1, BS = 99%). All *E. multiradiata*, *E. oxyglumis*, *E. persica* and *E. songarica* accessions form a strongly supported clade (core *Eremopoa* clade) in both trees (pp = 1, BS = 100%). In the plastid analysis *E. attalica*, *L. sintenisii* and *P. speluncarum* form a strongly supported clade (pp = 1, BS = 100%), with *L. sintenisii* sister to *E. attalica* (pp = 1, BS = 96%). In the nrDNA tree, *E. attalica* and *P. speluncarum* are sister taxa (pp = 0.99, BS = 77%) and *Lindbergella* is weakly supported as sister to this clade plus the core *Eremopoa* clade (pp = 0.97, BS = 59%). Within the core *Eremopoa* clade, all *E. oxyglumis* and *E. songarica* samples form a strongly supported clade in the nrDNA analysis (pp = 1, BS = 100%), whereas in the plastid analysis, these samples are divided between two strongly supported clades corresponding to *E. oxyglumis* plus one *E. songarica* sample (IRAN 20357, identification needs confirmation) (pp = 1, BS = 89%) and all remaining samples of *E. songarica* (pp = 1, BS = 100%). *Eremopoa multiradiata* and *E. persica* samples do not form a clade in either analysis, although all except one (*E. persica*, Soreng 9215) are strongly supported as a clade (pp = 1, BS = 95%) in the plastid tree.

The combined nrDNA and plastid Bayesian tree with proportional branch lengths is shown in Fig. 2. Prior to analysis, species and clades with positions incongruent (branch conflicts with ≥ 75% BS) between the nrDNA and plastid trees were removed, including *Lindbergella sintenisii*, *P. arctica*, *P. sect. Secundae* species and the *J*, *S*, and *V* clades. The *E* clade is strongly supported, as are its two subclades, *E. attalica-P. speluncarum* and the core *Eremopoa* clade (all pp = 1, BS = 100%). Both subclades are on long branches and separated by considerable genetic distance. The core *Eremopoa* clade is subdivided into two strongly supported clades: *E. multiradiata-E. persica* (pp = 0.99, BS = 96%) and *E. oxyglumis-E. songarica* (pp = 1, BS = 94%). *Eremopoa oxyglumis* and three of four accessions of *E. songarica* each form moderately or strongly supported clades (pp = 1, BS = 86%; pp = 1, BS = 100%, respectively).

In the combined nrDNA and plastid tree (Fig. 2), the *E* clade is strongly supported as sister (pp = 1, BS = 100%) to a clade comprising *Poa* supersects. *Homalopoa* (*H* clade) and *Poa* (*P* clade) and the *N* clade (*P. sect. Nanopoa* plus unassigned species). In the nrDNA analysis, the *E* clade is strongly supported as sister to clades *P+H* (not differentiated), *N*, and *X* (represented here by *P. arctica*) (Fig. 1). In the plastid analysis, the *E* clade is sister to a larger clade comprising clades *H*, *N*, and *P*, plus *J*, *S* and *V* (Fig. 1).
Discussion

Our molecular analyses of plastid and nuclear ribosomal DNA strongly support the position of *Eremopoa* and *Lindbergella* within the genus *Poa*. *Eremopoa* and *Lindbergella* were united in a clade along with *Poa speluncarum* with strong support in the plastid and combined trees (weak support in the nuclear tree). We call this set the E clade.
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Figure 2. Poa combined nrDNA and plastid Bayesian analysis showing placement of Eremopoa. Bayesian 50% majority rule consensus tree of combined nrDNA (ITS and ETS) and plastid data (trnT-trnL-trnF, matK and rpoB-trnC). Bayesian posterior probabilities are shown above branches, MP bootstrap values below branches. Major clades are indicated by colour and capital letter; outgroups are shown in black.

(Soreng et al. 2010, Cabi et al. 2017) and accept it as Poa subg Pseudopoa. In its recent usage, this subgenus was initially considered to include only Eremopoa (Zhu et al. 2006, Gillespie et al. 2007); here it is expanded to include Lindbergella and P. speluncarum.
Within the E clade, three taxa of southwest Turkey and Cyprus, *E. attalica*, *P. speluncarum* and *Lindbergella sintenisii*, are phylogenetically isolated from all the other species of *Eremopoa* sampled (the core *Eremopoa* clade). All three taxa formed a strongly supported clade in the plastid tree, while in the nuclear tree only the first two species form a clade and *L. sintenisii* is sister to this clade plus the core *Eremopoa* clade. The position of *L. sintenisii* is moderately supported as incongruent between the nuclear and plastid trees suggesting that the genus may be of hybrid origin; however, further studies are needed to confirm incongruence over lack of support.

All *Eremopoa* taxa sampled, excluding *E. attalica*, form a strongly supported clade in all trees, called here the core *Eremopoa* clade. This clade includes two strongly supported subclades in the combined nuclear-plastid tree, corresponding to *E. persica* s.l. and *E. altaica* s.l. In the first subclade, *E. multiradiata* is nested amongst *E. persica* samples, as is the sample originally determined as *E. medica* (TARI 35082). The *E. multiradiata* sample (Soreng 9240) comes from the type locality of *E. mardinensis* in SW Turkey and is a good match for that species, but we believe that *E. mardinensis* should be treated as a synonym of *E. multiradiata*. The *E. altaica* s.l. subclade in the combined tree includes a strongly supported and divergent clade of three *E. songarica* samples and a clade of *E. oxyglumis* plus one sample of *E. songarica* (identification needs confirmation). The position of *E. songarica* (tetraploid) with *E. oxyglumis* (diploid and hexaploid) is strongly supported in the combined and nuclear trees, but is weakly supported with *E. persica* (diploid) in the plastid tree. This, together with ploidy level, is suggestive of a possible hybrid origin for *E. songarica*, but this hypothesis needs to be further explored.

As noted in the introduction and Table 1, there has been no consensus on the taxonomy of *Eremopoa* species. Bor (1970, p. 49) wrote “As far as the genus *Eremopoa* Roshev. is concerned I am prepared to accept two species only: *Eremopoa persica* (Trin.) Roshev. and *E. bellula* (Regel) Roshev.” He considered *E. songarica*, *multiradiata* and *oxyglumis* “only worthy of varietal rank” as the single taxon, *E. persica* var. *songarica*. Tzvelev (1976), Cope (1982) and Mill (1985) dismissed the *E. bellula* form as indistinct, yet it was maintained as a species by Bor (1970) and Rahmanian et al. (2014). As such, the array of taxa has been treated as a series of species, subspecies or varieties. The taxonomy proposed by Tzvelev (1976) seems the most useful for treating *E. persica* s.l. and *E. altaica* s.l.; each is treated as a separate species with subspecies. His classification, supported by molecular data, is adopted here with some minor modifications.

Here, we present a synopsis of *P. subg. Pseudopoa* based on our current understanding. Further herbarium and molecular study is needed before a more comprehensive revision of the subgenus can be produced. We treat all *Eremopoa* species, *Lindbergella sintenisii* and *P. speluncarum* in *P. subg. Pseudopoa*. We merge all *Eremopoa* taxa and *L. sintenisii* into *Poa* and treat the *Eremopoa* taxa as five species. *Poa diaphora* Trin. is the correct name for *E. altaica* within *Poa*. Two subspecies, subsp. *diaphora* and *oxyglumis* (Boiss.) Soreng & G.H. Zhu, are recognised in *P. diaphora* based in part on their mostly clear separation in the plastid analyses and morphological distinctions. Subspecies *diaphora* includes three difficult to distinguish varieties: var. *diaphora* (formerly *E.
altaica), var. alpina and var. songarica (formerly E. songarica). Poa persica includes two subspecies and is clearly separated from both P. diaphora subspecies in the analyses. Most Eremopoa taxa already have names in Poa or the epithets used in Eremopoa are available in Poa (with one exception).

**Taxonomy**

*Poa subg. Pseudopoa* (K. Koch) Stapf in J. D. Hooker, Fl. Brit. India 7(22): 337. 1897 [1896].

Festuca [unranked] *Pseudopoa* K. Koch, Linnaea 21(1[4]): 409. 1848. *Poa sect. Pseudopoa* (K. Koch) Hack., Nat. Pflanzenfam. 2(2): 73. 1887. *Eremopoa* Roshev., Fl. URSS 2: 429, 756. 1934. Type. *Poa persica* Trin. ≡ *Festuca persica* (Trin.) K. Koch. *Lindbergia* Bor, Svensk Bot. Tidskr. 62: 467, 1968 (nom. illeg. hom., non Kindb., 1897). *Lindbergella* Bor, Svensk Bot. Tidskr. 63: 368. 1969. Type. *Poa sintenisii* H. Lindb. ≡ *Lindbergella sintenisii* (H. Lindb.) Bor.  

**Emended diagnosis.** Like species of other *Poa* subgenera, but annual (*P. speluncarum* a weak stooling perennial) and differing from other annual species of *Poa* by combination of sheath margins fused only near the base (basal sheaths fused to 16%, top sheath 4–12% [to 50% in *P. speluncarum*]), panicle branches scabrous along angles (*P. sintenisii* smooth), arranged in whorl-like groups of 5 to 27 per node (sometimes fewer in *P. diaphora* and *P. sintenisii*), sometimes the lower whorls of branches naked or with only a few sterile spikelets, flowers bisexual, glumes short (lower glume 2/7–2/3 (–3/4) the first lemma in length), 1-veined (3-veined in *P. sintenisii*), apex sharply pointed, sometimes apiculate, rachilla internodes exposed, scaberulous, cal- 

lus glabrous (or with a short crown of hairs in *P. sintenisii*), lemmas membranous to subchartaceous (*P. sintenisii* chartaceous), 3–5 veined, the intermediate veins faint when present, laterally compressed, but the keel not pronounced, glabrous or keel and marginal veins short sericeous (also sericeous between the veins in *P. sintenisii*), but keel scabrous distal to the hairs.

**Distribution.** Southwest Asia from Israel, Lebanon, Cyprus and Turkey eastwards through Transcaucasia, Iran, central Asia to western China and northwest India. Sporadic elsewhere, possibly adventive on Egypt’s North African coast but native east of the Red Sea, adventive in Europe and Canada.

**Notes.** A subgenus of seven species with several infraspecies, distributed mainly in semi-arid midlands to uplands (usually 300 m plus) to alpine, with winter spring / summer drought precipitation pattern, often along trails and roads, cultivated fields and pastures, around puddles, shallow springs, swales and vernal pools, snow beds, in pine/oak forests to open grasslands and deserts, also in shallow caves, in shallow sandy or stony soils or screes of igneous or metamorphic rocks of igneous or sedimentary origin, including pumice, lava, serpentine, shale, sandstone, limestone and marble.
Key to Poa subgen. Pseudopoa taxa and other annual species of Poa in the coincident geographic region

Plants annual (infrequently perennial or perenniating); anthers mostly 0.2–1 mm (to 1.7 mm in the weak stemmed, stooling perennial P. speluncarum, to 2.8 mm in the annual species Poa persica).

1 Palea keels soft hairy, never scabrous; callus glabrous (Poa sect. Micrantherae)...
   – Palea keels scabrous at least in part (if hairy in part, then distally scabrous); callus glabrous or hairy .................................................................

2 Anthers 0.2–0.5 mm long; panicle branches ascending, spikelets congested along the branches; plants light green ........................................... Poa infirma Kunth
   – Anthers 0.5–1 mm long; panicle branches spreading to ascending, spikelets moderately congested along the branches; plants darker green.......... Poa annua L.

3 Spikelets ovate; lemma keels densely villous medially, many hairs over 0.5 mm long; callus with a plicate web; anthers 0.4–0.8 mm long; panicles short (to 5 cm long), branches terete, smooth or sparsely scabrid, with 1–2 branches per node; upper culm sheath margins fused 25–35(–50)% their length; plants of vernal swales, Albania, Croatia, Greece, Bulgaria and European part of Turkey (Poa sect. Jubatae).............................................................. Poa jubata
   – Spikelets generally lanceolate; lemma keels glabrous or sericeous, hairs less than 0.3(–0.5) mm long; callus glabrous or with a short crown of hairs; anthers 0.2–2.8 mm long; panicles short or long, branches angled, smooth or scabrous, mostly with 2 to 27 branches per node, commonly appearing whorled; upper culm sheath margins fused 4–12% their length (40–50% in P. speluncarum); plants of Cyprus, Anatolian Turkey, southwards and eastwards across Asia into China (Poa subg. Pseudopoa, incl. Eremopoa)............................................................... 4

4 Uppermost culm sheath margins fused 40–50% their length; spikelets mostly 1-flowered; lemmas glabrous; callus glabrous; anthers 1.1–1.7 long; plants feeble, stooling perennials of caves and shady cool moist places in the Taurus Mts. of Turkey (rare) (Poa sect. Speluncarvae)................................................................. Poa speluncarum
   – Uppermost culm sheath margins fused 4–12% their length; spikelets (1–)2 to 10-flowered; lemmas glabrous or pubescent; callus glabrous or with a minute crown of hairs; anthers 0.2–2.8 mm long; plants slender tufted annuals........... 5

5 Lemmas 3-veined, apex slightly apiculate, lemmas and paleas subcoriaceous, sericeous along the keel(s) and marginal veins and between the veins; panicle branches smooth, mostly 1–5 at lower nodes; callus glabrous or with a short crown of hairs; plants endemic to Cyprus (usually on serpentine substrates) (Poa sect. Lindbergella)............................................................... Poa sintenisii
   – Lemmas 5-veined (veins commonly faint), apex infrequently apiculate, lemmas and paleas subchartaceous to subcoriaceous, glabrous between the veins or throughout; panicle branches scabrous, (1–)5–27 at lower nodes; callus glabrous; plants widespread, but not in Cyprus (Poa sect. Pseudopoa)............................. 6
Phylogeny and taxonomic synopsis of *Poa* subgenus *Pseudopoa*...

6 Panicles with 1 to 3 lower whorls of 7 or more sterile/naked or mostly sterile branches; panicles 7–20 cm long, effusely branched; lemmas 2–2.5 mm long, sericeous along the keel and marginal veins; spikelets 1–4(–6)-flowered ............ 7

– Panicles not or infrequently with some sterile lower branches; panicles 2–21 cm long, effusely to sparsely branched; lemmas 1.8–4.5 mm long, glabrous or sericeous along the keel and marginal veins; spikelets 1–12-flowered

7 Anthers 1.1–1.5 mm long; ligules 1.5–2.5 mm long; branches 7–20 per lower whorl; spikelets 1–4(–6)-flowered; plants of Zagros Mts., Iran

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P. nephelochloides

– Anthers 0.8–1 mm long; ligules 1–1.5 mm long; branches 7–15 per lower whorl; spikelets 1–3-flowered; plants of Taurus Mts., Turkey

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P. attalica

8 Anthers (1.2–)1.4–2.8 mm long; lemma apex blunt or obtuse to acutely pointed, with a broad membranous margin (*P. persica* s.l.)

– Anthers 0.2–1.3 mm long; lemma apex acute or narrowly acute to acuminately pointed, with a narrow membranous margin (blunt or slightly pointed in *P. millii* but then with 13–27 branches at lower panicle nodes)

9 Lemmas all glabrous or rarely with a few hairs near the base of the keel or marginal veins; spikelets (4–)5–10(–12)-flowered; panicles usually ¼–½ the plant height; anthers 1.5–2.8 mm long

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P. persica subsp. multiradiata

– Lemmas (at least of the lowest flower in a spikelet) minutely sericeous along the keel and marginal veins for ¼–⅔ the length; spikelets (2–)3–7(–9)-flowered; panicles usually ⅖–⅔ the plant height; anthers 1.2–1.4–1.8 mm long

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P. persica subsp. persica

10 Anthers mostly 0.2–0.6 mm long; lemmas 1.8–4.5 mm long, apex sharply pointed, usually glabrous, infrequently sparsely puberulent along the keel with one or a few soft hairs scattered near the base; spikelets (1–)2–3(–5)-flowered; plants 2–40 cm tall

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P. diaphora subsp. diaphora var. diaphora

– Lemmas 3.5–4.5 mm long; panicles (2–)3–8(–9) cm long, branches 1–5(–7) at lower nodes, divaricately rebranched and relatively stout, spikelets usually sparse and few; plants mostly 5–25(–30) cm tall

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P. diaphora subsp. diaphora var. diaphora

11 Lemmas 3.5–4.5 mm long in large specimens with many spikelets mm long; panicles 2–15(–20) cm long, branches (1–)3–8(–12) at lower nodes, divaricately rebranched or not, capillary to somewhat stout, spikelets sparse to crowded, few to many; plants 2–40 cm tall

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P. diaphora subsp. diaphora var. diaphora

12 Plants low growing, with dense fascicles of rebranching culms; culms 2–6 cm tall, with lateral inflorescences from lower culm leaves; panicles contracted to open,
1.5–4 cm long, included in tuft of basal leaves or slightly exerted; lemmas 3–3.5 mm long; plants alpine................. \textit{P. diaphora} subsp. \textit{diaphora} var. \textit{alpina}

- Plants low growing or taller, without fascicles of rebranching culms; culms solitary to several, mostly 10–40 cm tall, without lateral inflorescences; panicles effuse, usually more than 5 cm long, usually exerted; lemmas 1.8–3.5 mm long; plants of various habitats.............. \textit{P. diaphora} subsp. \textit{diaphora} var. \textit{songarica}

13 Spikelet pedicels mostly 2–5 mm long; panicle branches 5–18 at lower nodes, stiffly spreading, lower whorls never naked or with rudimentary spikelets; lemma apices acutely pointed; anthers 0.6–1.0(1.1) mm long .................................

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\textit{P. diaphora} subsp. \textit{oxyglumis}

- Spikelet pedicels mostly 5–10 mm long; panicle branches (9–)13–27 at lower nodes, slender, slightly flexuous, lower whorls sometimes with a few branches that are naked or with some rudimentary spikelets in addition to normal spikelets; lemma apices obtuse to acute, blunt or slightly pointed; anthers 0.8–1.3 mm long ................................................................. \textit{P. millii}

\textit{Poa} subg. \textit{Pseudopoa} sect. \textit{Pseudopoa} (K. Koch) Hack., Nat. Pflanzenfam. 2(2): 73. 1887.

\textbf{Emended description.} Tufted annuals. Leaf sheaths keeled, margins fused for 4–12% their length; blades flat to convolute, surfaces scabrous. Panicles open, with (1–)3–27 branches at lower nodes, lower whorls sometimes sterile; branches ascending to widely spreading, scabrous angled, with pedicels mostly equalling or up to 4× longer than their spikelets. Spikelets 1–10-flowered; glumes unequal, 1\textsuperscript{st} glume 1-veined, 2\textsuperscript{nd} glume 3-veined, usually reaching to less than \(\frac{3}{4}\) the adjacent lemma; rachilla internodes terete, scabrous; callus smooth, glabrous, with a round disarticulation scar; lemmas laterally compressed, weakly keeled, glabrous or short sericeous in lower half of the keel and also along the marginal veins, between veins smooth or scabrous, glabrous (rarely sericeous), 5-veined, intermediate veins obscure to distinct, margins narrowly to broadly scarious, apex obtuse to acuminate, sometimes briefly muticus. Flowers perfect, ovaries glabrous, anthers 0.2–2.8 mm long; caryopsis 1.5–2.5 mm long, narrowly elliptical, laterally compressed, fused to the palea, solid, hilum \(\frac{1}{8}\)–\(\frac{1}{6}\) the grain in length.

\textit{Poa attalica} (H. Scholz) Soreng, Cabi & L.J. Gillespie, comb. nov.
urn:lsid:ipni.org:names:77191831-1

\textit{Eremopoa attalica} H. Scholz, Willdenowia 10(1): 33, f. 1. 1980.

\textbf{Type.} \textsc{Turkey.} Antalya, “nordwestl. Antalya bei Termessos, ausgetrockneter Gebirgsbach”, 300 m, 23 Jul 1979, \textit{Kehl} s.n. (holotype: B! [B-100272775])

\textbf{Distribution.} Turkey (western Taurus Mts.).
Notes. We provisionally retain this species in sect. *Pseudopoa*, despite its divergent phylogenetic placement. The species is morphologically similar to other members of the section. As noted by Mill (1985), it is most like *Poa nephelochloides* Roshev., but the anthers are smaller. Some populations of *P. millii* approach *P. attalica* and are problematical to separate (see under *P. millii*). Further molecular study is needed to determine if the three species are closely related and if a new section is warranted.

*Poa diaphora* Trin., Mém. Acad. Imp. Sci. St.-Pétersbourg, Sér. 6, Sci. Math., Seconde Pt. Sci. Nat. 4,2(1): 69–70. 1836.

*Aira altaica* Trin., Mém. Acad. Imp. Sci. St.-Pétersbourg Divers Savans 2: 526. 1835.  
*Nephelochloa altaica* (Trin.) Griseb., Fl. Ross. 4(13): 367. 1852.  
*Poa diaphana* Boiss., Fl. Orient. 5: 611. 1884, nom. inval.  
*Eremopoa altaica* (Trin.) Roshev., Fl. URSS 2: 431. 1934.

Type. “Sterilissimus salsuginosis deserti editi Tschujae”, [1800–3000 m], July 1832, A. Bunge (lectotype, designated by Tzvelev 1976, pg. 480, and marked in herbarium: LE! [Trinius herbarium microform image 424-A4! p.p. Bunge 1832]; isolectotypes: LE [3 specimens: TRIN-2620.01! with original description (Trinius herbarium microform 312-A1), Trinius herbarium microform images 424-A3!, 424-A5!], K [K000789849 image!: specimen labelled “Aira altaica Trin. Altau”, “Acad. St. Petrop. mis. 8br 1835” is a good match for LE type material]). See Soreng et al. (1995) for explanation of Trinius herbarium citations.

Distribution. Egypt (Sinai Peninsula) to China (Xinjiang, Xizang).

Notes. Separating the four forms of *Poa diaphora* s.l. treated here is often difficult. Here we choose to recognise two subspecies as divided in the molecular plastid analysis. Subspecies *diaphora* and *oxyglumis* are most easily separated by the minute anthers (0.2–0.6 mm) combined with glabrous or nearly glabrous lemmas in the former and slightly longer anthers (0.6–1.1 mm) combined with hairy lemma keels and marginal veins in the latter. The other forms, *diaphora* s.s., *songarica* and *alpina* are essentially intergrading and are here treated as varieties in subsp. *diaphora*.

The specimen K000789848 (image!) (“Al. Bunge” ex hrbr. Alexandri Lehmann, Reliquiae botanicae, original det “Poa diaphora Tr.”) might be original material of *Aira altaica*, but RJS doubts it as it is not a good match for LE types; it is a taller plant more like K00789847 (also Reliquiae Lehmannianae), which is *Bunge* material collected 20 May 1842, in Karakum desert.

*Poa diaphora* subsp. *diaphora* var. *diaphora*  
Fig. 3A

*Poa persica* var. *diaphora* (Trin.) Asch. & Graebn., Syn. Mitteleur. Fl. 2: 437. 1900.  
*Eremopoa altaica* (Trin.) Roshev. subsp. *altaica*. 
Figure 3. Poa subgenus Pseudopoa sect. Pseudopoa. A P. diaphora subsp. diaphora var. diaphora, Chu, Kyrgyz Republic (Soreng et al. 7537) B, C P. persica subsp. persica, Adiyaman, Turkey (Soreng et al. 9215) B habit C closeup of base of plant showing keeled leaf sheaths and caniculate blades D, E P. persica subsp. multiradiata, Mardin, Turkey (Soreng et al. 9240) D habit E spikelet showing glabrous lemmas. Photos by R.J. Soreng.

Distribution. China (Xinjiang, Xizang), Kazakhstan, Kyrgyz Republic, Pakistan, Russia (Altai Mts.), Tajikistan, Turkey.

Notes. A single specimen recorded from Turkey (Kars Prov., Litvinov 4790 US ex K) evidently belongs to this variety and was also cited by Mill (1985) under E. songarica.
Phylogeny and taxonomic synopsis of *Poa* subgenus *Pseudopoa*...

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**Phylogeny and taxonomic synopsis of *Poa* subgenus *Pseudopoa***

**Poa diaphora** subsp. *diaphora* var. *alpina* (Boiss.) Soreng, Cabi & L.J. Gillespie, comb. nov.

urn:lsid:ipni.org:names:77191833-1

*Poa persica* var. *alpina* Boiss., Fl. Orient. 5: 610. 1884.

**Type.** Turkey. Plantae Lyciae, ad fonts reginis alpinae montis Elmalu, 25 Jun 1860, *E. Bourgeau 271* (lectotype, here designated: G [G00330280 image!]; isolecotypes: G [G00380172 image!, p.p. central and right top two samples], G [G0038173 image!], K [K-000789856 image!]).

**Distribution.** Armenia, Azerbaijan, Afghanistan, Georgia, Iran, Kyrgyz Republic, Pakistan, Turkey and Turkmenistan(?).

**Notes.** This taxon, accepted as *Eremopoa bellula* by several authors (see Names of Uncertain Application below), was first recognised infraspecifically by Boissier (1884) as *Poa persica* var. *alpina*. The variety is common in the highest elevations at which the genus occurs, in the alpine of Turkey, Iran and Afghanistan to the Pamir mountains, reaching 4000 m. Further study is needed to clarify the distinction of var. *alpina* from var. *diaphora* and these from *Eremopoa bellula*, as the material placed here appears heterogenous.

Of the six syntypes of var. *alpina* cited by Boissier (*Bourgeau 271*, hab. in alpinis, montes supra Elmali Lyciae [G00380172, G0038173, G00330280, K000789856]; *Kotschy 12*, Taurus Cilicius, 5–6000'; Prairies humides de la region alpine du Taurus, au Бoulgarmden [as 12d: G00330281, K000789851 image!]; *Balansa s.n.*, Jul-Aug 1855 [K000789857, P02358251 p.p. bottom right]; *Blanche s.n.*, Libani cacuminal; *Kotschy 477*, mons Kuh Delu Persiae australis, 10 Jun 1842 [BM000959359 image!, E!, G00308632 image!, P02358251! p.p. “fo. pygmaea” bottom left]), we select *Bourgeau 271* as the lectotype as it is typical of the form. As noted by Samuelsson (1950), the *Sintenis* syntype (mons Troodos, Cypri) represents a separate form that is treated here as *Poa sintenisii*. *Poa persica* var. “minor” Boiss. (cited by Mill, in Fl. Turkey 9: 492. 1985) is a nomen nudum since it is a herbarium name on *Bourgeau 271*, syntype of var. *alpina* Boiss.; this name is also inscribed on *Kotschy 12d* (p.p. G00308174), but the latter is original material, not a syntype, mentioned by Boissier (1884).

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**Poa diaphora** subsp. *diaphora* var. *songarica* (Schrenk ex Fisch. & C.A. Mey.) Soreng, Cabi & L.J. Gillespie, comb. nov.

urn:lsid:ipni.org:names:77191834-1

*Glyceria songarica* Schrenk ex Fisch. & C.A. Mey., Enum. Pl. Nov. 1: 1–2. 1841. *Nephelochloa songarica* (Schrenk ex Fisch. & C.A. Mey.) Griseb., Fl. Ross. 4(13): 367. 1852. *Nephelochloa persica* var. *songarica* (Schrenk ex Fisch. & C.A. Mey.) Regel, Trudy Imp. S.-Peterburgsk. Bot. Sada 7: 603. 1881. *Poa songarica* (Schrenk ex Fisch. & C.A. Mey.) Boiss., Fl. Orient. 5: 611. 1884. *Poa persica* var. *songarica*
Eremopoa songarica (Schrenk ex Fisch. & C.A. Mey.) Stapf, Fl. Brit. India 7(22): 337. 1897 [1896].

Eremopoa persica var. songarica (Schrenk ex Fisch. & C.A. Mey.) Roshev., Fl. URSS 2: 431, pl. 32, f. 11. 1934. Eremopoa persica var. songarica (Schrenk ex Fisch. & C.A. Mey.) Bor, Grass. Burma, Ceylon, India & Pakistan 532. 1960. Eremopoa altaica subsp. songarica (Schrenk ex Fisch. & C.A. Mey.) Tzvelev, Bot. Zhurn. (Moscow & Leningrad) 51(8): 1104. 1966. Poa diaphora subsp. songarica (Schrenk ex Fisch. & C.A. Mey.) Soreng & G.H. Zhu, Fl. China vol. 22: 266. 2006. Poa songarica var. argaea Hausskn. & Bornm. ex R.R. Mill, Fl. Turkey & E. Aegean Isl. 9: 491. 1985, nom. inval., as syn. of Eremopoa songarica.

Poa paradoxa Kar. & Kir., Bull. Soc. Imp. Naturalistes Moscou 864. 1841, nom. illeg. hom. Poa subtilis Kar. & Kir., Bull. Soc. Imp. Naturalistes Moscou 15(3): 532. 1842. nom. nov. (cited Poa paradoxa Kar. & Kir., 1941 [entry no.] 926). Type protologue. Hab. in herbosis ad rivulum Ai deserti Soongoro-Kirghisici, Jun, Karelin & Kiriloff. Type: Hab. in herbosis ad rivulum Ai deserti Soongoro-Kirghisici, Jun 1840, Karelin & Kiriloff (Herb. Fischer no. 504) (lectotype, here designated: LE; isotypes: P [P02663383!], W [W0028251 image!]).

Type. Ad fl. Karatal versus montes Karatau, 13 June 1840, H. Schrenk s.n. (holotype: LE; isotype: LE).

Distribution. Afghanistan, Armenia, Azerbaijan, China (Xizang), Georgia, Iran, Israel, Kazakhstan, Kyrgyz Republic, Tajikistan, Turkey, Turkmenistan and Uzbekistan.

Notes. Poa diaphora var. songarica was recently recorded (as Eremopoa songarica; determination verified here) from one locality in northernmost Israel (Danin and Fragman-Sapir 2016+). It was collected as a waif in Canada (Manitoba) in the 1950s (Stevenson 1965, as E. persica; Darbyshire 2007, as E. altaica: re-identified here), but is apparently not persistent (Darbyshire 2007, B.A. Ford, pers. comm. 2018).

Tzvelev (1976, pg. 480) cited “In herbidis Songaria ad rivulum Tschulak [Jun 1841], Karelin & Kiriloff 2123” (LE!) as type of P. subtilis (duplicates at BM000959360 image!, K000789846 image!, BR0000006600860 image!, P02663388!, P02663405!), but the type is the one [1840] collection cited by Karelin and Kiriloff (1841) distributed as Herb. Fischer no. 504.

Poa diaphora subsp. oxyglumis (Boiss.) Soreng & G.H. Zhu, Fl. China 22: 266. 2006.

Poa persica var. oxyglumis Boiss., Fl. Orient. 5: 610. 1884. Eremopoa oxyglumis (Boiss.) Roshev., Fl. URSS 2: 430, 756, pl. 32, f. 9–10. 1934. Eremopoa persica var. oxyglumis (Boiss.) Grossh., Fl. Kavkaza (ed. 2) 1: 268. 1939. Eremopoa altaica subsp. oxyglumis (Boiss.) Tzvelev, Bot. Zhurn. (Moscow & Leningrad) 51(8): 1104. 1966. Eremopoa persica var. oxyglumis (Boiss.) Rahmanian, Iran. J. Bot. 21(11): 214. 2014. nom. inval. isonym.
Phylogeny and taxonomic synopsis of *Poa* subgenus *Pseudopoa*...

**Type.** Turkey. In collibus prope Baibout, 17 Jul 1963, *E. Bourgeau* (lectotype, designated by Tzvelev 1976, pg. 479: LE [LE00009676]; isoolectotypes: LE [LE00009678 image!], P [P02358146! pp a, P03142400!]).

**Distribution.** Armenia, Azerbaijan, Georgia, China (Xizang), Kyrgyz Republic, Pakistan, Tajikistan, Turkey, Turkmenistan and Uzbekistan.

**Notes.** Most accounts have recognised this taxon at one rank or another, except Mill (1985) who treated it as a synonym of *E. songarica*. Several collections were cited in the original protologue: Tchihatcheff, Hab. in Ponto; Balansa, Ponto Lazico ad Djimil [Balansa 1549 G00308631, E, LE!, P02014318 (= subsp. oxyglumis), P02014317 (= *P. persica* subsp. *multiradiata*, US!); Huet, Erzurum [G00330279, G00308633]; *E. Bourgeau*, Armenia, in collibus et agris in cultis Armeniae Turcicae ad Gumuchkhane.

*Poa millii* Soreng, Cabi & L.J. Gillespie, nom. nov.
urn:lsid:ipni.org:names:604777374-2

*Eremopoa capillaris* R.R. Mill, Fl. Turkey & E. Aegean Isl. 9: 624, 490. 1985 (non *Poa capillaris* L. 1753). *Eremopoa persica* var. *ramosissima* Azn. ex R.R. Mill, Fl. Turkey & E. Aegean Isl. 9: 490. 1985, nom. inval.

**Type.** Turkey. Adana, distr. Feke, Sencan Dere nr Gurumze, 1300 m, 30 May 1952, *P. H. Davis, Dodds & Cetic* 19681 (holotype: E! [E00196495]; isotypes: BM! [BM000959355], K! [K000789852]).

**Distribution.** Turkey (central and eastern Taurus Mts. and adjacent ranges).

**Notes.** Morphologically *Poa millii* is intermediate between *P. persica* subsp. *persica* and *P. attalica*. However, we are not sure which of these it is actually related to or if it is a hybrid between them. The type approaches *P. persica* in having anthers 1.2–1.3 mm long and *P. attalica* in having abundant branching and sometimes having some sterile branches amongst the lower branch whorls. Much of the material of *P. millii* from further west than the type location from the Taurus Mts. has smaller anthers and is problematical to separate from *P. attalica*.

*Poa nephelochloides* (Roshev.) Soreng, Cabi & L.J. Gillespie, comb. nov.
urn:lsid:ipni.org:names:604777375-2

*Eremopoa nephelochloides* Roshev., in Köie, M., Beitr. Fl. Sudwest Iran I. Danish Sci. Invest. Iran In K. Jessen & R. Sparck. (Eds) Danish Sci. Invest. Iran, pt. 4: 50. 1945. *Eremopoa persica* var. *nephelochloides* Roshev., nom. invalid. as syn. of *E. nephelochloides.*
Type. Iran. 60 km north of Dizful, 3 May 1937, M. Köie 475 (lectotype, here designated: C [C10016935 image!]; isolectotype: LE).

Distribution. Iran (Zagros Mts.).

Notes. Due to its sterile whorls of branches, this species seems very close to Poa millii and P. attalica, but may be a derivative of P. persica since it has longer anthers than the previous taxa. Roshevits cited two gatherings of Köie: “Kechwar, 700 m (3 May 1937; no. 475). Chah-Bazan, 500 m” (Kechvar is about 60 km north of Dizful). The specimen at C has the same date and collection number as Roshevits cited and was annotated by Roshevits as this taxon; we select it as the lectotype. The anthers are ca. 1.1–1.2 mm as measured from the C photo and other characters seem to match P. attalica. The anther length is given as 1.5 mm in Roshevits’ diagnosis. The specimen clearly has the hyaline lemma apices of P. persica s.l. (in contrast to P. diaphora). However, these features are also present in the type of E. capillaris (= P. millii). Poa attalica has shorter anthers, ca. 0.8 to 1 mm, on the type (anthers not described by Scholz 1980 or Mill 1985). Poa nephelochloides and P. attalica may represent the same species, diagnosed as different from P. persica by sterile branches and from Nephelochloa orientalis Boiss. by glabrous lemmas (P. nephelochloides has pubescent lemmas). However, Poa nephelochloides and P. attalica are geographically isolated by over 1500 km and have different anther lengths.

Poa persica Trin., Mém. Acad. Imp. Sci. St.-Pétersbourg, Sér. 6, Sci. Math. 1(4): 373. 1830.

Festuca persica (Trin.) K. Koch, Linnaea 21(1[4]): 410. 1848. Nephelochla persica (Trin.) Griseb., Fl. Ross. 4(13): 366. 1852. Poa pamphylica Boiss., Diagn. Pl. Orient., ser. 1, 13: 58. 1854[1853?], nom. inval. as syn. of Poa persica. Eremopoa persica (Trin.) Roshev., Fl. URSS 2: 430, pl. 32, f. 8. 1934.

Type. Iran: in collibus ad Akar-Tschai prob. Karabagh, 1400–1900 m, 27 May 1829, Szowits 246 (lectotype, designated by Tzvelev 1976, pg. 479: LE! [photo E000327964!, TRIN-microform 434-B4!]; isolectotypes: LE [TRIN-2666.02!, TRIN-microform 434A8!, 434-B1!, 434-B2!, 434-B3!]).

Notes. Other original material includes: Iran, Prov. Aderbeidschan. distr. Khoi, ad Seidchadzi, 18 May 1828, Szovits 258 (LE!, LE0009678 [image!], LE0009679, LE0009680 [image!], LE0009681 [image!], W0028250 [image!]; In apricis prov. Aderbeidschan e Karabahg, Fischer [herb. Fischer] (K000789867 [image!]). Poa persica has two major variations: subsp. persica with pubescent lemmas and relatively narrower panicle length to plant height ratio; and subsp. multiflora with glabrous lemmas and relatively greater panicle length to plant height ratio, and often more flowers per spikelet.
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*Poa persica subsp. persica*

Fig. 3B, C

_Eremopoa persica var. typica_ Grossh., Trudy. Bot. Inst. Azerbaidzh. Fil. Akad. Nauk. S.S.S.R. 8: 268. 1939, nom. inval. _Eremopoa persica var. persica_. 1960.

*Poa ciliensis* Hance, Ann. Sci. Nat., Bot., sér. 4, 18: 234. 1862. Type protologue. In Tauro ciliicio, _Kotschy 529_. Type. In monte Tauro, aestate 1836, _Kotschy 529_, this from hb. H.F. Hance [via Reed 1887] no. 7498 (lectotype, _here designated:_ BM! [BM000551484, right hand plant (2 left hand specimens are *Poa diaphora var. songarica* and are clearly excluded from Hance’s description written on the sheet)]; isolecotype: P! [P02642319]).

_Glyceria taurica_ Steud., _Syn. Pl. Glumac._ 1: 286. 1854 (non _Poa taurica_ E. Pojarkova, 1965, _Poa × taurica_ H.N. Pojark., 1963). Type protologue. In monte Tauro, 1836, _Kotschy_ (Kotschy hrbr.). Type. In monte Tauro, Aestate, 1836, _Kotschy 529_ (lectotype, _here designated_: P! [P02642319]; isolecotype: BM [BM000551484 image!]).

**Distribution.** Armenia, Azerbaijan, Georgia, Egypt (north coast, possibly adventive), Iran, Iraq, Lebanon, Pakistan, Syria, Turkey; waif in France (introduced in wool, Marseille, _H. Roux_, P06768417!, P03370109!; RJS determination, 2015) and Norway (Greuter et al. 1984+).

**Notes.** Although Kotschy’s herbarium is mainly at W, a search of the W herbarium website did not turn up _Kotschy 529_ except as the genus _Arenaria_ from Tauro ciliicio or a _Scrophularia_ from Persia. _Kotschy 528_ at W is a _Poa_ of the _P. bulbosa_ complex from “In monte Tauro” in 1836. Presumably the earlier 1836 set was broken up and 529 ended up at BM and P. The anthers in the _G. taurica_ lectotype are 1.8 mm long and the lemmas are pubescent along the keel and marginal veins.

*Poa persica subsp. multiradiata* (Trautv.) Soreng, Cabi & L.J. Gillespie, comb. nov. urn:lsid:ipni.org:names:60477377-2

Fig. 3D, E

*Poa palustris var. multiradiata* Trautv., Trudy Imp. S.-Peterburgsk. Bot. Sada 4: 406. 1876. *Poa multiradiata* (Trautv.) Regel, Trudy Imp. S.-Peterburgsk. Bot. Sada 7: 620. 1880. _Eremopoa multiradiata_ (Trautv.) Roshev., Fl. URSS 2: 430, t. 32. 1934. _Eremopoa persica subsp. multiradiata_ (Trautv.) Tzvelev, Zlaki SSSR 479. 1976.

_Nephelochloa tripolitana_ Boiss. & Blanche, Diagn. Pl. Orient., ser. 2, 4: 133–134. 1859. *Poa persica var. major* Boiss., Fl. Orient. 5: 610–611. 1884. Type protologue. Hab. ad margines semitarum inter hortos ad Tripoliom Syriam _Blanche_, circa Byrouth in Libano _Gaillardot_. Type. _LEBANON_. S. Tripoli, dans les bords des chemins, 16
May 1854, Blanche 1267 (lectotype, here designated: JE [JE00005064 ex herb. Gaillardot, image!]). Note. Two of the original specimens turned up in our search, Blanche 1267 (JE00005064 ex herb. Gaillardot) and Gaillardot s.n. (JE00005065 ex herb Gaillardot no. 2323 [image!]). Blanche in 1869 (P02530724) might also be original material, with a distribution date rather than a collection date.

Eragrostis barbeyi Post, Bull. Herb. Boissier 5: 760–761. 1897. Type protologue. Habitat in collibus prope Midyat (Mardin), no. 38. Type. Turkey. Midyat, Hillsides, May 1895, 38 Barbey (lectotype, here designated by Nada Sinno Saoud & RJS: BEI! (image seen by RJS!)). Note. The BEI sheet has “No. 55 38 Barbey, 1895” (55 was originally written as 54 but the 4 written over by 5).

Eremopoa mardinensis R.R. Mill, Fl. Turkey & E. Aegean Isl. 9: 624, 488. 1985. Type. Turkey. Mardin, Mardin to Nusaybin, 8 km from Mardin, 850 m alt., shallow limestone gully, 22 May 1957, P. H. Davis & D. Hedge 28491 (holotype: E! [E00196494]).

Type. Armenia rossica, prope monasterium Kiptschach, 1875, G. Raddi. Type: Armenia rossica: prope monasterium Kiptschach in monte Alagos, Jun 1875, G. Radde 124 (holotype: LE! [photo E00326521!]; isotypes: LE, LE, W [W19160014191 image!]).

Distribution. Armenia, Georgia, Iran, Lebanon, Pakistan, Syria and Turkey.

Notes. The presence of hairs on the lemmas in material treated as “multiradiata” is confused in the literature. Mill (1985) indicates that E. multiradiata and E. persica s.s. have lemma keels hairy in the lower ⅓–⅓. We concur with Tzvelev (1976), who keyed E. persica subsp. persica as lemmas short pilose along the base of keel and marginal veins and subsp. multiradiata as lemmas glabrous or with a few solitary hairs.

Mill (1985) distinguished his new species Eremopoa mardinensis from E. multiradiata based on its glabrous lemmas, 8–12-flowered spikelets and florets strongly divergent from the rachilla. However, subsp. multiradiata also has glabrous lemmas (as noted above) and divergent florets (when spikelets are in flower) and its (4)5–9(10)-flowered spikelets overlap in number; therefore, we treat E. mardinensis as a synonym of E. multiradiata. The type material of Eragrostis barbeyi is from the same place as E. mardinensis and is clearly the same form (spikelets many-flowered); Nephelochloa tripolitana, with ca. 12–14-flowered spikelets, also appears to belong to this form. If E. mardinensis were accepted as a species, the basionym names Eragrostis barbeyi or Nephelochloa tripolitana would have priority.

Poa subg. Pseudopoa sect. Speluncarvae Soreng, Cabi & L.J. Gillespie, sect. nov. urn:lsid:ipni.org:names:60477378-2

Type. Poa speluncarum J.R. Edm.

Diagnosis. Differing from Poa sect. Pseudopoa in being perennial and stooling, with top culm sheath margins fused 40–50% their length and from almost all Poa in proximal spikelets being 1-flowered.
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Poa speluncarum J.R. Edm., Fl. Turkey & E. Aegean Isl. 9: 623. 473. 1985.

Type. Turkey. C4, Konya, distr. Ermenek, Kamis Dere between Ermenek and Oyuklu Dag., floor of caverns, 1400–1500 m, 14 Aug 1949, P. H. Davis 16180 (holotype: K! [K000641325]; isotype: E! [E00367874]).

Distribution. Turkey (central Taurus Mts.).

Notes. Poa speluncarum was described by Edmondson (1985) as an annual species of Poa sect. Ochlopoa Asch. & Graebn (≡ Poa sect. Micrantherae Stapf. Type: Poa annua). Our investigation found it to be a feeble, stooling perennial with sparsely scabrous panicle branches, uppermost sheaths closed up to half their length, spikelets sparsely scaberulous, mostly 1-flowered, the distal-most ones frequently 2(–3) flowered, anthers 1.1–1.7 mm, caryopsis 1.7–1.8 mm long, hilum 0.3 mm long and grain adherent to the palea. DNA data have clearly placed it in the Poa clade that includes Eremopoa species (E clade), either as sister to P. attalica (nuclear data) or as sister to P. attalica + P. sintenisii (plastid data). The species is odd in subgenus Pseudopoa for its perennial habit (albeit weak) and more closed sheaths, and in Poa generally by its mostly uniflorous spikelets. It is a very rare species that lives in the backs of shallow, moist, cool caves in the Taurus Mts., along with other cave endemics.

Poa subg. Pseudopoa sect. Lindbergella (Bor) Soreng, Cabi & L.J. Gillespie, sect. nov. urn:lsid:ipni.org:names:60477379-2

Lindbergia Bor, Svensk Bot. Tidskr. 62: 467, 1968 (nom. illeg. hom., non Kindb., 1897).
Lindbergella Bor, Svensk Bot. Tidskr. 63: 368. 1969.

Type. Poa sintenisii H. Lindb. ≡ Lindbergella sintenisii (H. Lindb.) Bor.

Diagnosis. Differing from Poa sect. Pseudopoa in: panicle branches smooth; lower glume 3-veined, up to 3/4 as long as the lower lemma; lemmas 3-veined, relatively firm, sericeous on keel marginal veins and sides; callus with short crown of hairs, the hairs 0.2 mm long; and palea keels sericeous in part.

Poa sintenisii H. Lindb., Årsbok-Vuosik. Soc. Sci. Fenn. 20 B (7): 5. 1942 (emend. Lindberg 1946).

Lindbergia sintenisii (H. Lindb.) Bor, Svensk Bot. Tidskr. 62: 467. 1968. Lindbergella sintenisii (H. Lindb.) Bor, Fl. Cyprus 63: 368. 1969.

Poa persica subsp. cypria Sam., Ark. Bot., n.s. 1(9): 417. 1950 [1951]. Type. Cyprus. auf dem Troodos, 20 Jun 1880, P. Sintenis 881 (lectotype, here designated: S; isolectotypes: B [B 10 0365891!], LD [LD1808162 image!, LD1808226 image!], G?, K [K000789835 image!, K000789836 image!, K000789837 image!], W [W0012225 image!, W0033518 image!, W00096518 image!, W0019026 image!]).
Type protologue. Cyprus. In pineto \((P.\ pallasiana)\) in m. Troodos lecta est. 1939.

Type. Cyprus. Troodos in pineto juxta via huid pol ab “Olympus Camp Hotel”, 22 Jun 1939, H. Lindberg s.n. (holotype: S [S-11-34137 image!]; isotypes: S [S-G-4941 image!], K [K000789839 image!], LD [LD1807330 image!], W [image!]).

Distribution. Cyprus (Mt. Troodos, endemic to serpentine rocks).

Names of uncertain application within \(Poa\) subgen. \(Pseudopoa\)

**Festuca bellula** Regel, Trudy Imp. S.-Peterburgsk. Bot. Sada 7: 594. 1881. **Eremopoa bellula** (Regel) Roshev., Fl. URSS 2: 431, pl. 32, f. 12. 1934.

Type protologue. Ad fontes calidos Araschan Bulak in Turkestania occidentali, Krause s.n. Type: Taschkenter Alatau, Araschan Bulak, 11 Jun 1871, (Hieronymous) Krause s.n. (holotype: LE [only one collection cited]).

Notes. *Eremopoa bellula* was applied by several authors to small densely tufted alpine annual plants of south-central and southwest Asia, which we recognise as \(P.\ diaphora\) var. *alpina* (based on *Poa persica* var. *alpina* Boissier [1884]). Tzvelev (1976, pg. 480) noted that the holotype collection of *E. bellula* appeared to be a mix of *altaica* (diaphora) and *songarica* forms (“p.p. max” = *E. altaica* subsp. *songarica*, somewhat intermediate between this subsp. and subsp. *altaica*, and “p.p. minor” = *E. altaica* subsp. *altaica*); he considered *E. bellula* to be a synonym of *E. altaica* subsp. *songarica*. Further study is needed to clarify the placement of *Eremopoa bellula* and determine if it is synonymous with \(P.\ diaphora\) var. *alpina*.

**Eremopoa glareosa** Gamajun., Bot. Mater. Gerb. Inst. Bot. Akad. Nauk Kazahsk. SSR 2: 2. 1964.

Type protologue. Usbekistanica, Tian Schan Occid., Bostandyk, fonts Aksar-sai, 28 Jul 1949, N. V. Pavlov s.n. (holotype: AA).

Notes. Tzvelev (1976, pg. 480) included *E. glareosa* as a synonym under *E. altaica* subsp. *songarica*, but noted that it is somewhat intermediate between this taxon and *E. altaica* subsp. *altaica*. As the protologue indicates the plants are 10–28 cm tall, with 3 to 4 florets per spikelet, spikelets 4–7 mm long and anthers 2.5 mm long, this is more likely to be *Poa persica*, perhaps subsp. *multiradiata*, since no pubescence is indicated.

**Festuca heptantha** K. Koch, Linnaea 21(3): 410. 1848. **Poa heptantha** (K. Koch) Steud., Syn. Pl. Glumac. 1: 255. 1854.

Type protologue. Im Hochgebirge, auf sumpfigen Wiesen, auf Urgestein, 5500 ft, C. Koch s.n. (holotype: B, probably destroyed).
Note. There is no location in the species protologue beyond the article title “Beitrag zu einer Flora des Orients”. Tzvelev (1976) indicated this name and the next, Festuca polygama, probably apply to Eremopoa persica and that the types of these were in Berlin (B). Clayton et al. 2002+ (GrassBase) reflect the same information. RJS was unable to locate type material of either of these two names at B, P or via internet searches.

Festuca polygama K. Koch, Linnaea 21: 409. 1848. Poa polygama (K. Koch) Steud., Syn. Pl. Glumac. 1: 255. 1854.

Type protologue. “Aus dem Wilhelm’schen Herbr als Poa persica.” Type: Wilhelms (holotype: B, probably destroyed).

Notes. Tzvelev (1976) indicates “Caucasus?”, but there is no location in the species protologue beyond the article title “Beitrag zu einer Flora des Orients”.

Excluded names

Eremopoa medica H. Scholz, Willdenowia 11(1): 96. 1981.

Type. Persia, Prov. Azerbaijan occid.: In pratis paludosis SE Shahpur versus lacum Rezaiyeh (Urmia), 1300 m; 12 Jun 1971, Rechinger 41820 (holotype: W [W1972-0000975 image!; isotypes: B! [B 10_0272774], GZU [GZU000201751 image!], WU [WU0033125 image!]).

Notes. The type collection of Eremopoa medica is clearly a perennial species of Puccinellia (possibly P. gigantea (Grossh.) Grossh.) with lemmas rounded on the back, a distinct short crown of callus hairs and papillae common on vegetative structures (pedicels and leaves). Material cited as E. medica in Rahmanian et al. (2014, fig. 5) appears to us to be Poa persica subsp. persica; their description and illustration indicate an annual habit, pubescent lemmas and panicles with 10 or more branches per whorl. The single specimen (TARI 35082) cited was included in our molecular analysis and formed a clade with other P. persica accessions in all trees.

Invalid names, not vouchered

Festuca amberstiana Nees, Ill. Bot. Himal. Mts. 417. 1839, nom. nud., name in list, no voucher.

Notes. Kew GrassBase (Clayton et al. 2002+) indicates it is equal to E. persica. The specimen K00078950 (ex P) (image!), Voyage V. Jacquemont aux Indes orient. no. 1902, has this name on the label. The specimen is certainly P. diaphora, not P. persica.
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Table A1. *Eremopoa*, *Lindbergella*, *Poa* and outgroup samples used in the phylogenetic analyses. Ingroup samples are arranged by plastid clade (pl), nuclear clade (nr) and section. Voucher information (herbarium indicated in parentheses) and country of origin are provided; where there is no collector or collector number, the herbarium specimen number is given. GenBank Accession numbers are provided for ITS, ETS, *trnT-trnL-trnF*, *matK* and *rpoB-trnC* sequences for each sample; those in BOLD are new to this study.

| pl | nr | Section | Taxon | Voucher | Country | ITS | ETS | TLF | matK | *rpoB-trnC* |
|----|----|---------|-------|---------|---------|-----|-----|-----|------|-------------|
| A A | A | Alpinae | *Poa alpina* L. | Gillespie 6299 (CAN) | USA, Colorado | GQ324483 | GQ324287 | DQ353985.2 | K5M23888 | K5M24001 |
| A A | A | Alpinae | *Poa bidentis* Haenke ex Willd. | Hajkova et al. 2004-12 (US) | Bulgaria | GQ324490 | GQ324295 | GQ324402 | KY378861 | KY378827 |
| A A | A | Alpinae | *Poa caespitosa* Boiss. | (JACA 166095) | Spain | GQ324522 | GQ324346 | GQ324432.2 | KY378876 | KY378842 |
| A A | A | Alpinae | *Poa hispida* Boiss. & Orph. | Gillespie et al. 10400 (CAN) | Turkey | KM523802 | KM523729 | KM524088 | KM525901 | KM524014 |
| A A | A | Arenariae | *Poa bactriana* subsp. *glabriflora* (Roshev.) Tzvelev | Gauba (IRAN 21237) | Iran | KX118734 | KX118716 | KX118751 | MH921344 | MH921369 |
| A A | A | Arenariae | *Poa bulbosa* L. | Catalan 13-2000 (UZ) | Spain | EU792388 | GQ324297.2 | AH015557.3 | KY378863 | KY378829 |
| A A | A | Arenariae | *Poa bulbosa* subsp. *vivipara* (Koeler) Arcang. | Soreng & Soreng 5814 (US) | USA, Nevada (introd.) | GQ324492 | GQ324298 | GQ324404 | MH921345 | MH921370 |
| A A | A | Arenariae | *Poa sinaica* subsp. *sinaica* Steud. | Soreng & Cabi 9249 (US) | Turkey | KX118748 | KX118731 | KX118766 | KY378886 | KY378852 |
| A A | A | Arenariae | *Poa timoleontis* Heldr. ex Boiss. | Soreng et al. 7509-1 (US) | Greece | KX118750 | KX118732 | KX118768 | MH921354 | MH921379 |
| E E | E | Lindbergella | *Lindbergella sintenisii* (H. Lindb.) Bor | Hand 6102 (US) | Cyprus | MH921326 | MH921310 | MH921393 | MH921342 | MK060117 |
| E E | E | Pseudopoa | *Eremopoa attalica* H. Scholz | Gillespie et al. 10612 (CAN) | Turkey | MH921311 | MH921299 | MH921380 | MH921329 | MH921355 |
| E E | E | Pseudopoa | *Eremopoa multiradiata* (Traurv.) Roshev. | Gillespie & Levin 10612 (CAN) | Turkey | MH921311 | MH921299 | MH921380 | MH921329 | MH921355 |
| E E | E | Pseudopoa | *Eremopoa oxyglumis* (Boiss.) Roshev. | Gillespie & Levin 10578 (CAN) | Turkey | MH921317 | MH921301 | MH921384 | MH921333 | MH921359 |
| E E | E | Pseudopoa | *Eremopoa oxyglumis* | Gillespie et al. 10584 (CAN) | Turkey | MH921318 | MH921302 | MH921385 | MH921334 | MH921360 |
| E E | E | Pseudopoa | *Eremopoa oxyglumis* | Soreng & Cabí 8855 (US) | Turkey | MH921315 | MH921299 | MH921382 | MH921331 | MH921357 |
| E E | E | Pseudopoa | *Eremopoa persica* (Trit.) Roshev. | Assadi & Vosoughi (TARI 24939) | Iran | MH921321 | MH921305 | MH921388 | MH921337 | MH921363 |
| E E | E | Pseudopoa | *Eremopoa persica* | Mosaffarian (TARI 53671) | Iran | MH921320 | MH921304 | MH921387 | MH921336 | MH921362 |
| E E | E | Pseudopoa | *Eremopoa persica* | Soreng & Cabí 9215 (US) | Turkey | KY378812 | KY378823 | KY378816 | KY378879 | KY378845 |
| E E | E | Pseudopoa | *Eremopoa persica* | Yazdani & Fazilat (ISRA 51968) | Iran | MH921319 | MH921303 | MH921386 | MH921335 | MH921361 |
| E E | E | Pseudopoa | *Eremopoa persica* | Mosaffarian & Nowrouzi (TARI 35082) | Iran | MH921322 | MH921306 | MH921389 | MH921338 | MH921364 |
| E E | E | Pseudopoa | *Eremopoa songariensis* (Schrenk ex Fisch. & C.A. Mey.) Roshev. | Assadi & Mosaffarian (TARI 36867) | Iran | MH921324 | MH921308 | MH921391 | MH921340 | MH921366 |
| E E | E | Pseudopoa | *Eremopoa songariensis* | Iran (IRAN 20357) | Iran | MH921323 | MH921307 | MH921390 | MH921339 | MH921365 |
| E E | E | Pseudopoa | *Eremopoa songariensis* | Soreng & Güney 4165 (US) | Turkey | EU792400 | GQ324311 | DQ353988.2 | KY378868 | KY378834 |
### Phylogeny and Taxonomic Synopsis of Poa subgenus Pseudopoa

| pl | nr | Section | Taxon | Voucher | Country | ITS     | ETS     | TLF     | matK    | rpoB-trnC |
|----|----|---------|-------|---------|---------|---------|---------|---------|---------|-----------|
| E  | E  | Pseudopoa | Eremopoa songarica | Soreng & Cabi 95:20 (US) | Turkey | MH921325 | MH921309 | MH921392 | MH921341 | MH921367 |
| E  | E  | Spathularis | Poa spathularis, J. R. Edm., Soreng et al. 8:202 (US) | Turkey | MH921328 | MH921312 | MH921395 | MH921353 | MH921378 |
| H  | P-H | unclassified | Poa pseudodulcis Bor, Soreng et al. 8:246 (US) | Turkey | KX118747 | KX118729 | KX118765 | MH921352 | MH921377 |
| H  | P-H | Aculifoliae | Poa planifolia Kentz, Peterson et al. 1923 (US) | Argentina | KM523800 | KM523727 | KM524087 | KM523896 | KM524009 |
| H  | P-H | Brizeides | Poa pisiformis Labill., Druce, Giligie et al. 7:381 (CAN) | Australia | GQ324534 | GQ324361 | GQ324445 | KM523897 | KM524010 |
| H  | P-H | Homalopoa | Poa reflexa Vasey & Scribn., Soreng et al. 8:100 (US) | Turkey | MH921327 | MH921311 | MH921394 | MH921343 | MH921368 |
| H  | P-H | Homalopoa | Poa asiatica var. h. Scholm & Byfield, Soreng & Cabi 95:20 (US) | USA Colorado | GQ324543 | KX118730 | GQ324450 | KY378882 | KY378848 |
| H  | P-H | Homalopoa | Poa chiaxi Vill., Soreng & Cabi 95:20 (US) | Russia | EU792404 | GQ324299 | EU854590 | KM523890 | KM524003 |
| H  | P-H | Homalopoa | Poa chiaxi Vill., Soreng et al. 8:246 (US) | Germany | GQ324493 | GQ324300 | GQ324405 | MH921346 | MH921371 |
| H  | P-H | Homalopoa | Poa masendarama Freyn & Stirn., Anadi (TARI 73254) | Iran | KX118743 | KX118725 | KX118761 | MH921351 | MH921376 |
| H  | P-H | Homalopoa | Poa occidentalis Vasey, Peterson & Valdes Rena 18918 (US) | Mexico | KU756540 | KU763436 | KU763514 | KY378877 | KY378843 |
| H  | P-H | Homalopoa | Poa remota Forselles, Soreng & Cabi 95:20 (US) | Kyrgyz Republic | GQ324545 | GQ324372 | GQ324452 | KY378883 | KY378849 |
| H  | P-H | Homalopoa | Poa fendlerianna (Steed.) Vasey, Giligie 6292 (CAN) | USA, Colorado | EU792403 | GQ324319 | DQ354027 | KY378869 | KY378835 |
| H  | P-H | Madropoa | Poa fendlerianna (Steed.) Vasey, Giligie 6292 (CAN) | USA, Colorado | EU792403 | GQ324319 | DQ354027 | KY378869 | KY378835 |
| H  | P-H | unclassified | Poa calycina (J. Presl) Kunth, Peterson et al. 17923 (US) | Peru | EU792425 | KU763935 | EU792467 | KY378864 | KY378830 |
| H  | P-H | unclassified | Poa caulicula (J. Presl) Kunth, Peterson et al. 17923 (US) | Peru | EU792425 | KU763935 | EU792467 | KY378864 | KY378830 |
| J  | J  | Jubatae | Poa jubata A. Kern., Soreng et al. 9029:2 (US) | Turkey | KY378810 | KY378820 | KY378814 | KY378873 | KY378839 |
| J  | J  | Jubatae | Poa jubata A. Kern., Soreng et al. 9029:2 (US) | Turkey | KY378811 | KY378821 | KY378815 | KY378874 | KY378840 |
| M  | M  | Micrantherae | Poa infirma Kunth, Catalan 3-2000 (UZ) | Spain | GQ324516 | GQ324334 | GQ324427 | KY378871 | KY378837 |
| M  | M  | Micrantherae | Poa supina Schrad., Soreng & Casenoue 5:950:2 (US) | USA, cult. (from Europe) | EU792387 | GQ324383 | DQ353984 | KY378888 | KY378854 |
| N  | N  | Nanopoa | Poa trichophylla Heldr. & Sart. ex Boiss., Soreng et al. 7:508 (US) | Greece | GQ324554 | GQ324386 | GQ324461 | KY378889 | KY378855 |
| N  | N  | unclassified | Poa dolosa Boiss. & Heldr., Soreng et al. 7:495:1 (US) | Greece | GQ324502 | GQ324312 | GQ324414 | KM523891 | KM524004.2 |
| N  | N  | unclassified | Poa icosa var. pelagia (H. Scholz) Soreng, Giligie et al. 10:492 (CAN) | Turkey | KX118744 | KX118726 | KX118762 | MH898827 | MH898844 |
| N  | N  | unclassified | Poa ussuriensis Velen., Stoneberg SH:7 (US) | Bulgaria | GQ324527 | GQ324352 | GQ324437 | KY378892 | KY378858 |
| N  | S  | Secundae | Poa curtifolia Scribn., Soreng & Soreng 5:64:7-1 (US) | USA, Washington | EU792394 | KY378819 | DQ353994.2 | KY378867 | KY378833 |
| N  | S  | Secundae | Poa secundula J. Presl. subsp. secundula Soreng & Soreng 5:81:2 (US) | USA, Nevada | EU792393 | KU763450 | DQ353991 | KY378884 | KY378880 |
| pl | nr | Section | Taxon | Voucher | Country | ITS | ETS | TLF | matK | rpoB-trnC |
|----|----|---------|-------|---------|---------|-----|-----|-----|------|----------|
| N  | S  | Secundae | Poa stenantha Trin. | Soreng & Soreng 6068-1 (US) | USA, Alaska | KU756554 | KU763455 | DQ354057.2 | KY378887 | KY378853 |
| P  | P+H| Macropoa | Poa densa Troitsky | Soreng & Cabi 9106 (US) | Turkey | KX118738 | KX118720 | KX118755 | MH921347 | MH921372 |
| P  | P+H| Macropoa | Poa bucharica Roshev. | Soreng et al. 7662 (US) | Kyrgyz Republic | KX118735 | KX118717 | KX118752 | KY378862 | KY378828 |
| P  | P+H| Macropoa | Poa diversifolia (Boiss. & Balansa) Hack. ex Boiss. | Gillespie et al. 10529 (CAN) | Turkey | KX118739 | KX118721 | KX118756 | MH921348 | MH921373 |
| P  | P+H| Macropoa | Poa ibERICA Fisch. & C.A. Mey. | Soreng et al. 7977 (US) | Russia, Cabardino-Balkaria | KY118741 | KX118723 | KX118758 | MH921349 | MH921374 |
| P  | P+H| Macropoa | Poa longifolia Trin. subsp. longifolia | Soreng et al. 7945 (US) | Russia, Cabardino-Balkaria | KY118742 | KX118724 | KX118760 | MH921350 | MH921375 |
| P  | P+H| Macropoa | Poa sibirica Roshev. subsp. sibirica | Olonova 2003-45 (CAN) | Russia, Khakassia | GQ324547 | KY378824 | GQ324455 | KY378885 | KY378851 |
| P  | P+H| Poa | Poa irkatica Roshev. | Ksannoevsky 2002-7 (CAN) | Russia, Irkutsk | EU792402 | GQ324335 | DQ354007.2 | KY378872 | KY378838 |
| P  | P+H| Poa | Poa pratensis L. subsp. pratensis | Gillespie et al. 10592 (CAN) | Turkey | KX118746 | KX118726 | KX118764 | KY378880 | KY378846 |
| X  |   | Malacanthae | Poa arctica R. Br. subsp. arctica | Gillespie & Aiken 5701 (US) | Canada, Nunavut | GQ324487 | GQ324291 | DQ340009 | KY378860 | KY378826 |
| R  | R  | Paradichloria | Poa cookii (Hook.f.) Hook.f. | Hemion Gen1 (P) | Subantarctic Islands, Crozet I. | EU792383 | GQ324306 | EU792454 | KY378866 | KY378832 |
| S  | S  | Abbreviatae | Poa flexuosa Sm. subsp. flexuosa | Brochmann 2000-3-1 (CAN) | Norway | GQ324520 | GQ324342 | GQ324418 | KY378875 | KY378841 |
| S  | S  | Abbreviatae | Poa pseudoabbreviata Roshev. | Soreng & Soreng 6032-1 (US) | USA, Alaska | EU792398 | GQ324370 | DQ353997 | KY378881 | KY378847 |
| S  | S  | Stenopoa | Poa biebersteinii H.N. Pojark. (cf) | Gillespie & Cab 10327 (CAN) | Turkey | KY944706 | KY944668 | KY987089 | KY944622 | KY987044 |
| S  | S  | Stenopoa | Poa glauca Vahl | Gillespie & Aiken 5701 (CAN) | Canada, Nunavut | AY237839 | GQ324324 | GQ324421 | KY378870 | KY378836 |
| S  | S  | Stenopoa | Poa palustris L. | Gillespie 6641 (CAN) | Canada, Ontario | EU792396 | KY378822 | DQ354000 | KY378878 | KY378844 |
| S  | S  | Tischonopoa | Poa compressa L. | Gillespie 6547 (CAN) | Canada, Quebec | EU792395 | KY378818 | DQ354003 | KY378865 | KY378831 |
| V  | V  | Pandemos | Poa trivialis L. subsp. trivialis | Soreng 4681-1 (US) | USA, Maryland (introod.) | GQ324555 | GQ324387 | GQ324462 | KY378891 | KY378857 |
| V  | V  | Pandemos | Poa trivialis subsp. sylvatica (Guss.) H. Lindb. | Gillespie et al. 10368 (CAN) | Turkey | KY378813 | KY378806 | KY378817 | KY378890 | KY378856 |
| Y  | Y  | Sylvestres | Poa annuella Elliott | Soreng 4680 (US) | USA, Maryland | EU792379 | GQ324294 | DQ353979 | KM523889 | KM524002 |
| Y  | Y  | Sylvestres | Poa sal OFFSET Fernald & Wiegand | Gillespie 7043 (CAN) | Canada, Ontario | EU792378 | GQ324374 | EU792451 | KM523899 | KM524012 |
| Y  | Y  | Sylvestres | Poa wolfii Scribn. | Soreng & Soreng 5800 (US) | USA, Missouri | EU792377 | GQ324389.2 | AH015556.2 | KY378893 | KY378859 |
|     |     | outgroup | Agrostis latifolia (R. Br.) Griseb. | Gillespie et al. 6586 (CAN) | Canada, Nunavut | EU792351 | GQ324245 | DQ353969 | KM523924 | KM523954 |
|     |     | outgroup | Milium effusum L. | Soreng 7771 (US) | Sweden | KM523785 | KM523711 | KM524072 | KM523870 | KM523983 |
|     |     | outgroup | Neopoa andina (Trin.) Soreng & L.J. Gillespie | Soreng & Soreng 7182 (US) | Chile | EU792354 | GQ324275 | DQ353971 | KM523874 | KM523987 |
|     |     | outgroup | Phleum montanum K. Koch | Gillespie et al. 10614-2 (CAN) | Turkey | KM523793 | KM523720 | KM524081 | KM523883 | KM523996 |
|     |     | outgroup | Phleum pratense L. | Soreng 7943 (US) | Russia, Stavropol | KM523796 | KM523723 | KM524084 | KM523886 | KM523999 |
**Supplementary material I**

**Table S1. Characteristics of the DNA alignments and data partitions and parameters and summary statistics of the PAUP and Bayesian analyses**

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Data type: (measurement/occurence/multimedia/etc.)

Explanation note: Five DNA sequence alignments for *Poa* were analysed: ETS, ITS, *matK*, *rpoB-trnC* and *trnT-trnL-trnF* (TLF). For each data partition (five individual markers, plastid, nuclear and combined), the number of samples and the total number of aligned characters are given. For the PAUP analyses, the following statistics are given: the number of parsimony informative (PI) characters, percentage of characters that are parsimony informative, maximum parsimony (MP) tree length (L), number of most parsimonious trees, consistency index excluding uninformative characters (CI) and retention index (RI). Parameters used and statistics of the Bayesian analyses, as determined by the Akaike Information Criterion (AIC) implemented in jModeltest, are given as follows: likelihood score (-lnL), number of substitution schemes, substitution rates (rAC, rAG, rAT, rCG, rCT, rGT), character state frequencies (fA, fC, fG, fT), substitution model, proportion of invariable sites and gamma shape parameter.

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