Poa densa (Poaceae), an overlooked Turkish steppe grass, and the evolution of bulbs in Poa

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Source: Willdenowia, 46(2) : 201-211

Published By: Botanic Garden and Botanical Museum Berlin (BGBM)

URL: https://doi.org/10.3372/wi.46.46201
**Poa densa (Poaceae), an overlooked Turkish steppe grass, and the evolution of bulbs in Poa**


**Abstract:** *Poa densa* Troitsky is a characteristic species of the high steppe to low alpine vegetation of Turkey. It was overlooked in the *Flora of Turkey*, and although subsequently reported from a few stations in W part of C Anatolia, is actually relatively common and widespread across the semi-arid C and N steppes. Here we provide a key to related species, a full description, photographs, 2C value of nuclear DNA content, and a distribution map, and discuss its classification in the genus. The synonym *Festuca conferta* is lectotypified. DNA phylogenetic analysis and morphology data indicate *P. densa* is allied to species of *P. subg. Poa* sect. *Macropoa*, rather than to the *P. bulbosa* complex of *P. subg. Ochlopoa* sect. *Arenariae*, and support multiple origins of the basal bulb in the genus *Poa*.

**Key words:** bulbs, evolution, taxonomy, lectotypification, Turkey, Anatolia, Poaceae, Gramineae, Poa, Poa densa, Festuca conferta

**Article history:** Received 21 November 2015; peer-review completed 26 January 2016; received in revised form 29 February 2016; accepted for publication 10 March 2016.

**Citation:** Cabi E., Soreng R. J., Gillespie L. & Amiri N. 2016: *Poa densa* (Poaceae), an overlooked Turkish steppe grass, and the evolution of bulbs in *Poa*. – Willdenowia 46: 201–211. doi: http://dx.doi.org/10.3372/wi.46.46201

**Introduction**

*Poa densa* Troitsky was not reported in the *Flora of Turkey* account of *Poa* L. by Edmondson (1985). Tzvelev (1976) was unaware of the occurrence of the species in Turkey. Bor (1970) did not include it in the *Flora Iranica*. Up to the time of these major accounts for grasses it was only known from Transcaucasia [Grossheim (1939: map 231) mapped it from 11 places in Azerbaijan, Georgia and Armenia], Turkmenistan and N Iran (Tzvelev 1976).

The absence of pre-1970s collections of *Poa densa* from Turkey at ANK, B, E, G, ISTE, K, LE and W partially explains the absence of reports for Turkey in the major regional Floras. Curiously, however, as we document here, *P. densa* seems to be a fairly common and characteristic in the mid-to upper steppe zone from SW to NE Turkey. Despite there being at least six collections of the species made between 1973 and 1981, by such prominent collectors as A. Baytop, Y. Akman and M. Doğan, with vouchers deposited at ANK and ISTE (under other species names), the species was overlooked for Turkey until Parolly & al. (2002) reported three newer collections of the species from SW Turkey as a disjunction from the Irano / Caucasian-Turkmenian region. In the checklist of the *Poaceae* of Turkey, Cabi & Doğan (2012) reported 30 *Poa* taxa including *P. densa*. It was also noted more recently in treatments of grasses for Armenia (Gabrieljan 2010) and Iran (Akhani & Scholz 1998) and mapped for Iran (Kavousi & al. 2015). It was reported for Xinjiang, China, by Liu (2003), but no material of this species was found in KUN, NAS, PE or other herbaria surveyed by R.J.S. for the *Flora of China* (Zhu & al. 2006).

Here we report many additional collections of *Poa densa* in Turkey and map them. We also provide a detailed...
description and diagnosis, diagnostic photographs, discuss its lectotypifications, and lectotypify its synonym, Festuca conferta Turoisky ex Grossh. We undertook flow-cytometric and phylogenetic investigations to determine its ploidy level and what it might be related to, and in particular how many times bulbs might have arisen within Poa.

Material and methods

Collections of Poa densa were sought under this and other names at ANK, ANKF, B, E, EGE, G, ISTE, KNYA and US, with K checked by Maria Vorontsova (herbarium acronyms after Thiers 2015+). New collections were made by some of us in 1991, 1993, 2013, 2014, 2015, and several other specimens were reported in the literature (Parolly & al. 2002) for Turkey. All the Turkish and other specimens known to us are listed in the Taxonomy section.

Flow cytometry

Leaves of field-collected Poa densa accessions were used as plant material. Nuclear suspensions were prepared by chopping 0.5 cm² of leaf tissue of P. densa and 0.5 cm² of internal standard leaves, with a razor blade in a glass Petri dish containing 500 μl isolation buffer (the commercial Partec extraction buffer). Vicia sativa 'Orakefe' (2C = 3.65 pg of DNA, Tiryaki & tuna 2012) was used as an internal reference standard for all samples. Nuclear suspension was then filtered through a 50 μm cell-tricks disposable filter and mixed with 2 ml staining solution and incubated for 30–60 sec. Flow-cytometric analysis was performed using the flow cytometer Partec CyStain UV Precise (code No. 05-5002; Partec GmbH, Germany) at the Department of Field Crops, Faculty of Agriculture of Namik Kemal University. At least 10000 nuclei were analysed per sample. Four individuals were analysed in three different days to avoid errors due to instrumental drift.

Molecular analysis

Thirty-one samples were chosen for the molecular analysis representing 28 species and infraspecific taxa and including three samples of Poa densa (Table 1) and seven other bulbous taxa. Poa subg. Sylvestres (V. L. Marsh ex Soreng) Soreng & L. J. Gillespie (P. autumnalis Muhl. ex Elliott, P. saltuensis Fernald & Wiegand), well supported as the basal Poa clade in previous analyses of Poa and subtribe Poinae (Gillespie & al. 2007, 2008, 2009; Soreng & al. 2010), was used as the outgroup.

One plastid (trnT-trnL-trnF – TLF), and two nuclear ribosomal (nr) DNA markers, internal transcribed spacer (ITS) and external transcribed spacer (ETS), were sequenced. TLF includes two spacer regions and the trnL intron (Taberlet & al. 1991). For ETS partial sequences of approximately 500 base pairs at the 3’ end were used (Gillespie & al. 2009). DNA extraction and sequencing protocols, as well as primers, are described in Gillespie & al. (2007, 2008, 2009, 2010).

Sequences were assembled, checked and edited using either Sequencher ver. 4.7 (GeneCodes Corp., http://genecodes.com) or Geneious ver. 6.1.5 (Biomatters Ltd, http://www.geneious.com). Sequences were aligned using the MAFFT ver. 7.017 plugin (Katoh & al. 2002; Katoh & Standley 2013) followed by manual adjustment in Geneious. The three alignments (TLF, ITS, ETS) were concatenated in Geneious.

Maximum parsimony (MP) analyses were performed in PAUP* 4.0b10 (Swofford 2002) on the separate and combined alignments using the heuristic search command with default settings, including tree-bisection reconnection (TBR) swapping and saving all multiple shortest trees (Multtrees). Strict consensus trees were computed in PAUP and prepared in FigTree v1.4.0 (Rambaut 2006–2014). Branch support was assessed using MP bootstrap analyses performed in PAUP using a heuristic search strategy with default settings and 1000 bootstrap replicates, each with five random addition sequence replicates. Strict consensus trees were inspected for conflicting topologies, with incongruence identified by branch conflicts having ≥ 70 % MP bootstrap support (BS). Since no supported incongruence was found between the ITS and ETS trees, and subsequently between the ITS+ETS and TLF trees, a final analysis was run on the combined ITS+ETS+TLF dataset.

Results

Cytology

Our flow-cytometric data suggest that the species is diploid in Turkey (voucher Soreng & al. 8110, US, NAKU) with a 2C value of 2.0 pg of DNA (Vicia standard), which is intermediate between other studied diploid Poa species.

Molecular analysis

The combined ITS+ETS+TLF data matrix comprised 3090 characters, of which 188 were parsimony informative; ITS, ETS and TLF partitions had aligned lengths of 599, 558 and 1933 characters, respectively, of which 54, 67 and 67 were parsimony-informative. The ITS+ETS+TLF analysis resulted in 16 most parsimonious trees, 392 steps long, with a consistency index (CI) excluding uninformative characters of 0.77; the strict consensus tree with bootstrap support values is shown in Fig. 1.

The sampled ingroup Poa species form three strongly supported major clades (BS = 100): P. subg. Ochlopoa (Asch. & Graebn.) Hyl., the separate unclassified lineage called the N-clade (see Gillespie & al. 2009; Soreng & al. 2010), and P. subg. Poa, with the latter two sister clades (BS = 100). Poa subg. Poa is further divided into two subclades: P. supersect. Poa (BS = 86) and P. supersect. Homalopoa (Dumort.) Soreng & L. J. Gillespie (type:
P. chaixii (Vill.) (BS = 79); note that the classification of P. pseudobulbosa Bor is uncertain, although the tree shows weak support for a relationship with P. supersect. Homalopoa. Poa densa resolves in the P. subg. Poa supersect. Poa clade with good support (BS = 86%). Relationships within the P. supersect. Poa clade are for the most part weakly supported here, as is the precise position of P. densa.

Species with bulbs are distributed in four clades (Fig. 1): (1) Poa densa and P. diversifolia (Boiss. & Balansa) Hack. ex Boiss. in P. supersect. Poa; (2) P. pseudobulbosa in or near P. supersect. Homalopoa; (3) P. pelagis H. Scholz in the N-clade; and (4) P. bactriana Roshev., P. bulbosa L., P. sinaica Steud. and P. timoleontis Heldr. ex Boiss. in P. subg. Ochlopoa sect. Arenariae (Hegetschw.) Stapf (type: P. bulbosa L.) mixed with species of P. sect. Alpinae (Hegetschw. ex Nyman) Stapf (type: P. alpina L.).

Discussion

The centre of distribution of Poa subg. Ochlopoa sect. Arenariae, in which P. densa was historically placed, and the only section of the genus characterized by bulbous based shoots, is in the Mediterranean region (11 spp.), with a secondary centre in the C Asian steppes (two to four additional species). Soreng (1998), unaware that P. diversifolia was also bulbous, listed 14 species for the section (following Tzvelev 1976; Scholz 1985, 1986; Soreng & al. 1997). Poa densa is easily recognized by its indurate thickened basal sheaths forming bulbs, firmer than those that occur in the P. bulbosa complex (P. sect. Arenariae = P. sect. Bolborophorum Asch. & Graebn., P. subsect. Bulbosae V. Jirásek), in combination with short (to 0.5 mm long), truncate basal leaf ligules, firm (non-withering), filiform basal leaf blades, and firm, glabrous, 5-veined lemmas. Although Tzvelev (1976) placed it in P. sect. Poa subsect. Bulbosae, along with P. bactriana, P. bulbosa, P. sinaica, P. timoleontis, and P. vvedenskyi Drobow, Troitsky (1928) originally allied it to P. diversifolia, a previously unclassified species of W Turkey and the Levant. Sokolovskaya & Probatova (1979) argued that it belonged to Tzvelev’s P. sect. Macropoa F. Herm. ex Tzvelev (type: P. longifolia Trin.), in which they and he included P. bucharica Roshev., P. iberica Fisch. & C. A. Mey., P. long-
Table 1. Poa taxa, our classification, voucher information and GenBank accession numbers for collections in Fig. 1. Sequences with GenBank numbers in **bold** are new in this paper.

<table>
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<th>Taxa</th>
<th>Subgenus</th>
<th>Section</th>
<th>Voucher</th>
<th>Country of origin</th>
<th>GenBank accession numbers</th>
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<td>Sylvestres</td>
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<td>Arenariae</td>
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<th>Voucher</th>
<th>Country of origin</th>
<th>GenBank accession numbers</th>
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<td>Iran</td>
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folios and P. sibirica Roshev., rather than to his P. sect. Poa subsect. Bulbosae. It differs from P. diversifolia, to which it is genetically related (Fig. 1), by its smooth, glabrous lower culms (P. diversifolia is minutely scabrous to strigulose below the culm nodes), and short, narrow culm leaf blades (elongate and broader in P. diversifolia), and short, densely to slightly loosely contracted panicles. Bulbs are weakly expressed in the rare Turkish endemic. Roshev. (both bulbous), and short, narrow culm leaf blades (elongate and broader in P. diversifolia), and short, densely to slightly loosely contracted panicles. Bulbs are weakly expressed in the rare Turkish endemic.

Fig. 1 shows that species with bulbs occur in four clades. Poa densa (both bulbous) are closely related to species of P. sect. Macropoa that are not bulbous, and these are distantly related to other species placed in the P. bulbosa complex. Poa pelagis represents a third appearance of a bulbous species in the phylogram. Poa pseudobulbosa represents another possible origin of bulbs within P. subg. Poa, but its position is poorly supported, and we cannot say with confidence that it belongs to P. supersect. Homalopoa.

The plastid and nrDNA sequences of Poa densa from Turkey and Iran are nearly identical, and all the sequences generated are very similar to P. diversifolia and P. longifolia.

Following our genotype classification (Soreng & al. 2010), Poa densa and P. diversifolia share "P" plastid genotypes and an "h" nrDNA genotype similar to species of P. subg. Poa sect. Macropoa; P. bucharica, P. iberica, P. longifolia, P. maszeranera Freyn & Sint. and P. sibirica. We place the previous set of species all in P. subg. P. sect. Macropoa. Poa pratensis L., of P. sect. Poa, also characterized as Ptn, likely picked up part of its allopolyploid genome from P. sect. Macropoa (see also Patterson & al. 2005). We accept the species of the P. bulbosa complex (see Soreng 1998) in P. subg. Ochlopoa sect. Arenariae, where P. akmanii Soreng & al., P. bactriana, P. bulbosa, P. sinaica and P. timoleontis are characterized as having "OAOA" genotypes, as do members of P. sect. Alpiniae species (incl. P. alpina, P. badensis Haenke, P. ligulata Boiss., etc.). Poa pelagis has an "Nn" genotype. The classification of the latter species is under investigation; it was previously reported in DNA studies as P. sinaica, by Patterson & al. (2005), or as P. bulbosa in part by Soreng (1990) and Gillespie & Soreng (2005). Scholz first described this taxon as P. sinaica var. graeca H. Scholz, then (in 1985) recognized it as a species related to P. eigi Feinbrun and P. hackelii Post, still within the P. bulbosa complex.

Evidently basal bulbs arose more than once in Poa, at least once in P. sect. Arenariae (OAOA) and again in P. sect. Macropoa (Ptn), under similar environmental pressures of arid Mediterranean climate, or the bulbous habit was transferred from one species complex to the other via introgressive hybridization. We are inclined to the former hypothesis based on our DNA results and morphological differences between P. sect. Arenariae and P. sect. Macropoa, but cannot categorically reject the latter without deeper genetic analyses. However, for P. pelagis we are inclined to the latter hypothesis, for now, as it is difficult to separate from P. sect. Arenariae except by its shorter ligules and often strigulose lower sheaths. Curiously, Poa is the only genus of grasses with true bulbs; all others with swollen culm bases actually have corms (Kellogg 2015), but some species of Poa do have corms: P. drummondiana Nees (Australia) and P. tuberifera U. J. Faurie ex Hack. (Japan).

**Taxonomy**

**Key to Poa densa in Turkey (plants with thickened basal sheaths)**

1. Spikelets viviparous or normal-flowered; normal lemmas (if any) pubescent on keel and marginal veins, and sometimes between veins; lemmas 5-veined, or obscurely 5-veined; callus with or without a dorsal tuft of hairs (web); ligules of basal leaves 0.5–15 mm long; basal blades soon withering or moderately firm and persisting in form when dry (P. sect. Arenariae: P. bulbosa complex).

- Spikelets normal-flowered; lemmas and calluses totally glabrous; lemmas distinctly 5-veined; ligules all short (c. 1 or less in length) and truncate; basal blades moderately firm and persisting in form when dry (P. sect. Macropoa s.s. + P. pseudobulbosa) ............... 2

2. Culms densely retrorsely or bi-directionally appressed strigulose to aculeolate or finely scabrous just below lower or middle culm leaf nodes; panicles generally loose, long-branched, and many-flowered; basal blades involute, slender, firm; culm blades wider and softer; plants (30–)40–100+ cm tall ............... P. diversifolia

- Culms smooth, or at most sparsely scabrous below lower culm nodes (in P. pseudobulbosa); panicles contracted or If loose then sparsely flowered, short-branched; culm leaf blades ± like those of basal shoots in form, usually equal in length or shorter; plants 10–60 cm tall ................. P. bulbosa

3. Panicles loose and sparsely flowered; rachilla internodes elongated, plainly visible; culm leaves well developed, c. equalling the basal blades in length .... P. pseudobulbosa

- Panicles dense, or slightly loose; rachilla internodes contracted, mostly hidden; culm leaf blades similar in form to the basal leaf blades, but shorter, the uppermost very short ............... P. densa

**Revision of Poa densa**


= *Festuca conferta* Troitsky ex Grossh., Fl. Kavkaza 1: 115. 1928 (post 20 Nov 1927) [non *Poa conferta* Elliott

Description — Herbs perennial, hermaphroditic, without rhizomes or stolons, tufted, tufts dense, green to bluish green; culm base with innermost lateral sheaths thick, coriaceous-cartilaginous, elongate-bulbous (bulbs 1–3 cm long), usually exposed, tillers all intravaginal, cataphylls absent, prophylls elongated (c. 1 cm long?). Culms (15–)25–60 cm tall, erect, slender, several per tuft, slightly decumbent, smooth or lightly scabrous below panicle, smooth below nodes, glabrous. Leaves mostly basal; leaf sheaths slightly to strongly compressed, strongly imbricated at base; inner ones thickened (elongate bulbous), outer ones papery to scarios, loose, those on culm tightly clasping, flag-leaf sheath 8–14 cm long, margins fused for 36–53% of their length; ligules of culm leaves 0.5–1.1 mm long, scarious, whitish, abaxially densely scabrous, apex truncate to slightly rounded, asperous, of sterile shoots 0.2–0.7(–1) mm long; blades of culm 0–5 cm long, 0.5–1(–1.5) mm wide, much shorter than their sheath, folded with involute margins, abaxially scabrous along keel and sometimes along some veins, adaxially smooth, apex narrowly prow-tipped, reduced distally, upper one sometimes rudimentary or absent, of sterile shoots 2–10 cm long, fairly firm, involute, capillary (c. 0.5 mm in diam.), lowest with few distinct whitish ribs expressed abaxially, scabridulous between ribs. Panicles 2.5–8 cm long, 0.8–1.5 cm wide, contracted, or slightly spreading in anthesis, mostly congested, with (10–)40–60 spikelets, pedicels and axis moderately to densely scabrous, axis with (2 or)3–5 branches at lowest nodes; primary branches, erect to ascending, weakly angled, moderately to densely scabrous, pedicels mostly less than ¼ their spikelets in length, longest branches 0.5–2 cm long, with 4–8

Fig. 2. *Poa densa* (E. Cabi 5135) – A: habit; B: inflorescence; C: spikelet; D: culm upper node; E: basal bulbous shoots; F: ligule. – Photographs by E. Cabi.
spikelets per branch. Spikelets 3.6–5.5(–9) mm long, lanceolate (to broadly ovate); vivipary absent (in Turkey); florets 2 or 3(–7); rachilla internodes 0.5–1 mm long, densely muricate to sparsely scabrous, glabrous; glumes unequal, keels scabrous distally, margins narrowly hyaline, surfaces sometimes and edges scabridulous distally, thinly chartaceous, thinner than lemma; lower glumes 1.9–2.5(–3) mm long, lanceolate, 1–3-veined; upper glumes 2.5–3.2(–3.7) mm long, 3-veined, margins and apex hyaline; callus glabrous; lemmas 3.2–4.2(–4.9) mm long, 5-veined, chartaceous to subcoriaceous, lanceolate, green or commonly violaceous, distinctly keeled, glabrous, keel and marginal veins scabrous, intermediate surfaces muricate, distally and marginally scabridulous, intermediate veins faint to moderately distinct extending to near apex, margins very narrowly hyaline, edges finely scabridulous, apex acute, sharply pointed; palea equalling lemma, keels scabrous, innercostal zone muricate to sparsely scabridulous. Flowers bisexual; anthers 1.5–2.2(–3) mm long; Caryopsis c. 2.5 mm long, ventrally distinctly sulcate, hard, glabrous, tightly adherent to palea; hilum oval (c. 0.5 mm long). Chromosome number: 2n = 14.

Phenology — Flowering from June to July.

Ecology — High steppe grasslands to low alpine, 1100–2550 m, calcareous, gyposeous, serpentine and igneous substrates. Commonly associated with shrubby Astragalus L. species, Thymus marschallianus Willd., Bellardiochla Chiov., Festuca L. and Koeleria Pers. species, normal-flowered Poa sinaica and viviparous varieties of P. sinaica, P. timoleontis and P. bulbosa (the last sometimes of ambiguous species determination and called “Poa bulbosa viviparous aggregate” by us).

Distribution — Mapped in Fig. 3: Armenia, Azerbaijan, Georgia, Iran, Turkey, to SW Turkmenistan (Kopedağ; Kovalevskaia 1968).

Lectotypifications — Festuca conferta was published in Grossheim’s Flora Kavkaza (1928) sometime after the signature page dated “20 Nov 1927”. Troitsky’s Poa densa was published sometime in 1928. We do not know which publication came first, and neither author mentioned the name of the other’s taxon, so Pl. densa was not an avowed replacement name (non P. conferta Ell., as implied by Tzvelev 1976, but not by Grossheim 1939). Festuca conferta was validated in a key to the genus in Russian [English translation: “Low internodes thickened, bulbous. Densely turfed. Culms 30–50 cm tall. Leaves stiff, green. Panicle 3–8 cm with short branches. Lemma obscurely keeled. Georgia: Tiflis, Armenia: Erevan. On dry slopes of the middle mountain zone. [No.] 420. Festuca conferta Troitsky (med.).”]. Grossheim did not cite any specimens, and Festuca conferta has remained untypified, but, as the diagnosis and distribution agree with Troitsky’s publication of P. densa, and the names have been treated as synonyms since accounts by Roshevitz (1934) and Grossheim (1939), we tie the two names together by lectotypifying the former name on the lectotype of the latter.

The lectotypification history of Poa densa is a bit convoluted. Troitsky (1928) cited four collections (syntypes) in “Horti Petrop.”, “Horti Tili.” and “Musei Agric. Armeniae”, Roshevitz (Fl. SSSR 2: 378. 1934) chose one of these as type: “(Tiflisskii Raion, Garedzhinskaya Steppe, 17 June 1927, N. Troitsky) Type in Tiflis [now TBI], colype in Lenningrad”. Apparently, Roshevitz either did not realize the “17 June 1927” sheet at LE was not duplicated in the Tiflis herbarium, or the duplicate there was lost. Evidently, there are two original Troitsky sheets at TBI, TBI-1025700 and TBI-1025701, collected on “11 June 1926”, but none collected on “17 June 1927”. Both the 11 June 1926, and the 17 June 1927, collections at LE have Roshevitz’s printed annotation slips with “Poa densa Troitsky” and the date of “1930” hand-written. Tzvelev (1976: 451), without explanation for the change of herbarium, cited the 17 June 1927 sheet as the “Type in LE”. Although the 17 June 1927 sheet at LE was not found by R.J.S. in 2010, its existence is confirmed by an old photograph at E (EO0326518). E. T. Gabrielyan’s herbarium annotations of 2003 on the 11 June 1926 gathering noted TBI-1025700 as the lectotype and TBI-1025701 as the duplicate as isolectotypes (images available via JSTOR Global Plants: http://plants.jstor.org/), but she subsequently accepted the 17 Jun 1927 Troitsky specimen at LE as the lectotype (Gabrielyan 2010).

Remarks — The first collections of Poa densa in Turkey that we are aware of were made near Beypazari, Ankara Region, by Asuman Baytop & Yildirim Akman (s.n.) and the city of Erzurum by Adem Tatlı (s.n.) in 1973. We now have identified 30 records for Turkey from across a wide swath of the country. Tzvelev (1974, 1976: 451) noted P. densa to be rarely viviparous (var. vivipara Tzvelev), but that the viviparous material (type from Azerbaijan) may represent hybridization between P. densa and P. bulbosa s.l. Gabrielyan (2010) mentioned that vivipary occurs sometimes in P. sinaica and usually in P. bulbosa, but wrote nothing about it in P. densa in Armenia. Although there are viviparous plants of the P. bulbosa complex just about everywhere in Turkey, and P. densa and P. sinaica are commonly sympatric or parapatric, we have not seen any viviparous material we would ascribe to P. densa, nor any specimens that seemed intermediate between P. densa and other bulbous-based species in the field or in herbaria. Kelley & al. (2009) indicated P. densa might be a nanoploid apomict, but we suspect their sample (PI 380984) to represent another species (possibly a contaminant), since it differs from two independent estimates that P. densa is diploid: Sokolovskaya & Probatova (1979) reported P. densa as diploid, 2n = 14, and our flow-cytometry data agree with that.
Specimens examined — (* = DNA vouchers).


Armenia: Delizhan distr., in pascuis pagi Nadezhdino, 1926, M. Timofoew & W. Kiurtschan (ERE [not seen]; syntype of Poa densa); Pambaski Kherbet in vicinitate oppida Sevan, 1900–2200 m, 17 Jul 1975, V Vasik s.n. (B); Yerevan distr., in pascuis Eldida, 1926, A. Schelkownikow (ERE [not seen]; syntype of Poa densa).

Georgia: Tiflis, Garedzenskaya steppe, 11 Jun 1926, N. Troitsky s.n. (LE [photo K-969/167], TBI-1025700 [image]; TBI-1025701 [image]; syntypes of Poa densa); Tbilisi region, Gargjiiskaya steppe, 17 Jun 1927, N. Troitsky s.n. (LE [photo at E: E00326518]; lectotype of Poa densa and Festuca conferata).

Iran: Golestan, Mohsenian 25247 (IRAN*); Khorasan, Akhani 11010 (B).

Conclusions

Within Turkey, Poa densa is readily recognizable, widespread, and characteristic of the high steppe regions of C to NE Anatolia. Its distribution extends more or less continuously N from the W Taurus mountains, and to the NE into the mountainous regions S of the Karadeniz Dağları (Pontic Mountains), occurring between 1000 and 2250 (–2500) m in altitude. The number of new records of this distinctive species of Poa in Turkey suggests the flora of the high Anatolian steppes is not as sufficiently documented as one might have expected and calls for more systematic collecting in this region. Poa densa is here reclassified from P. sect. Arenariae to P. sect. Macropoa. Bulbs in Poa appear to have arisen at least twice, or as many as four times.

Acknowledgements

We thank Musa Doğan for his support to the project by revising Poa in Turkey; Yıldırım Akman for his introduction of R.J.S. to the flora of Turkey and providing assistance in field work; Osman Ketenoğlu, Latif Kurt, Kerim Güney and Ümit Bingöl for guidance and assistance to R.J.S. in field work in 1991 and 1993; Konstantin Romaschenko for translations from Russian; Kunchi Gandhi for a scan of the Festuca conferata protologue; the Kew library for a scan of the Poa densa protologue; Maria Vorontsova for checking for this species at K; Metin Tuna for access to the flow cytometer; Tuğrul Koruklu, Ayse Mine Gencler Özkan and Osman Tugay for access to the AEF, ANK and KNYA university herbaria in 2014; the curators of the B, E and G herbaria for loans; TÜBİTAK-KBAG for support of Grant no. 212T113 to E.C.; TÜBİTAK-BİDEB for support that made possible R.J.S.’s visit to Namik Kemal University; and two anonymous reviewers for their helpful comments on an earlier version of this paper.

References


