



Genus *Eremurus* (Asphodelaceae) in the flora of Uzbekistan

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ABSTRACT

In this study, 13 morphological characters in 32 species of *Eremurus* (Asphodelaceae) from Uzbekistan were examined and subjected to cladistic analysis. In the consensus tree, species from subgenus *Eremurus* clustered together, but did not form a distinct clade sister to *Henningia*. The subrotate flowers, tepals with one abaxial nerve, and short stamens were found to be ancestral character states in *Eremurus*. Based on the morphological traits analyzed, a new key to identify the species of *Eremurus* in Uzbekistan is provided. The main synonyms, nomenclatural types, descriptions, ecological data, distribution and photos are also given for each taxon. *Eremurus korolkowii* and *E. baissunensis* are considered non-synonymous with *E. anisopterus* and *E. luteus*, respectively.

Keywords: cladistic analysis; Central Asia; synopsis; taxonomy; morphology; *Ammolirion*; *Henningia*

Introduction

Eremurus M.Bieb. (Asphodelaceae Juss.; *Asphodeloideae* Burnett of (APG IV 2016) has relatively recently started to attract attention due to its great ornamental importance (Kamenetsky & Rabinowitch 1999), unique chemical composition (Dhiraj & Anjna 2011; Salehi et al. 2017; Tosun et al. 2012; Zhou et al. 2010), regional taxonomic diversity (Makhmudjanov et al. 2019; Naderi et al. 2009; Safar et al. 2014; Tojibaev et al. 2020), rarity and conservation priorities (Eker 2020; Lazkov & Sultanova 2014). *Eremurus* is distributed in arid and semiarid areas of Central Asia, the Caucasus, Afghanistan, Iran, Pakistan, Iraq, Turkey,

Crimea, Lebanon, India and China (Wendelbo & Furse 1969; Xinqi et al. 2000). The genus is easily recognized by its leafless inflorescence with more than 50 flowers and its rhizomatous rootstock (Fedtschenko 1935).

Eremurus differs from *Asphodeline* Rchb. by having non-membranous leaf sheaths at the base of the inflorescence and from *Asphodelus* L. by the unbranched inflorescence (Naderi et al. 2009). It differs from other genera of the Asphodelaceae, for example the geographically distant and predominantly African genera *Trachyandra* Kunth, *Bulbinella* Kunth, and *Kniphofia* Moench, by having densely flowered inflorescences, a loose raceme, and perianth

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segments not fused towards the base, respectively (Bredenkamp 2019; Perry 1987).

Eremurus, comprising 45 to 50 (Li et al. 2020) or 59 (Eker 2020) taxa, has been divided into two subgenera and three sections (Wendelbo 1982). Subgenus *Eremurus* is characterized by having light brownish green or cream tubular or campanulate flowers, incurved tepals with 3 or 5 nerves abaxially and exerted filaments; species of subgenus *Henningia* (Kar. & Kir.) Baker have white, pink or yellow rotate flowers, mostly included filaments and tepals with one nerve abaxially (Naderi et al. 2009).

The main diversity center of *Eremurus* is Central Asia, where 45 species (24 endemic) occur (Vvedensky & Kovalevskaya 1971). With the newly described species, including hybrid taxa, the number of species of *Eremurus* comes to nearly 50 (Khassanov 2015). In Uzbekistan, according to Vvedensky (1941), the genus includes 20 species, but recent studies have shown that the number of species in this region is at least 32 (Tojibaev et al. 2014). Among them, four species (*E. iae* Vved., *E. nuratavicus* Khokhr., *E. chloranthus* Popov, *E. korolkowii* Regel) are endemic and 13 species are sub-endemics of Uzbekistan.

Apart from the study of 24 species in the Iranian area conducted by Naderi et al. (2009), there have been no morphology-based phylogenetic studies in the center of diversity for the genus. For this reason, the purpose of our study was (i) to analyze the morphology of the species of *Eremurus* in Uzbekistan; (ii) to use the morphological data to infer the phylogeny of the genus; and (iii) to provide a key to identify the species. Compilation of a new checklist of *Eremurus* in Uzbekistan, a new key for identification and GIS maps of their distribution is important for the «Flora of Uzbekistan» project (Sennikov et al. 2016), the aim of which is a taxonomic revision of the national flora (Sennikov 2016; Sennikov 2017; Sennikov 2019; Tojibaev et al. 2017).

Materials and Methods

The morphological data used in the phylogenetic analysis (Table 1) were obtained by examining fresh materials collected in Uzbekistan (Appendix 1, Fig. 1), herbarium specimens preserved in TASH, LE, and MW (herbaria acronyms according to Thiers (2021)), and from the literature (Fedchenko 1968; Goloskokov 1958; Kashenko 1951; Vvedensky 1932, 1941, 1963). As an additional source of information, we also examined data available at Plantarium (<https://www.plantarium.ru>). Thirty-two taxa of *Eremurus* and four outgroups *Trachyandra* (*T. malosana* (Baker) Oberm.), *Asphodeline* (*A. tenuior* subsp. *tenuiflora* (K.Koch) Tuzlaci., *A. prolifera* (M.Bieb.) Kunth), and *Asphodelus* (*A. tenuifolius* Cav.) were included in the analysis. The data matrix of thirteen informative characters with relevant character states is in Table 2. The polarity of characters was determined using the outgroup method (Maddison & Maddison 2019; Maddison et al. 1984). A dichotomous key to the species of *Eremurus* in Uzbekistan was compiled using traditional methods (Hagedorn et al. 2010).

Cladistic analysis was performed on the data matrix (Table 2) using the maximum parsimony method (MP) as implemented in PAUP* version 4.0b10 (Swofford 2002), following Naderi et al. (2009). All characters were equally weighted. One hundred replications of the closest addition sequence were selected in the heuristic search option with ACCTRAN optimization and TBR (tree bisection reconnection) branch-swapping with MulTrees on and steepest descent off. We then applied a successive re-weighting strategy (Farris 1969) to improve the tree indices and to decrease the effect of characteristics representing homoplasy on tree topologies. In the next step, clade support was evaluated by bootstrapping (Felsenstein 1985) with 20,000 replications with the heuristic search option, closest addition sequence, TBR branch swapping and MulTrees off.

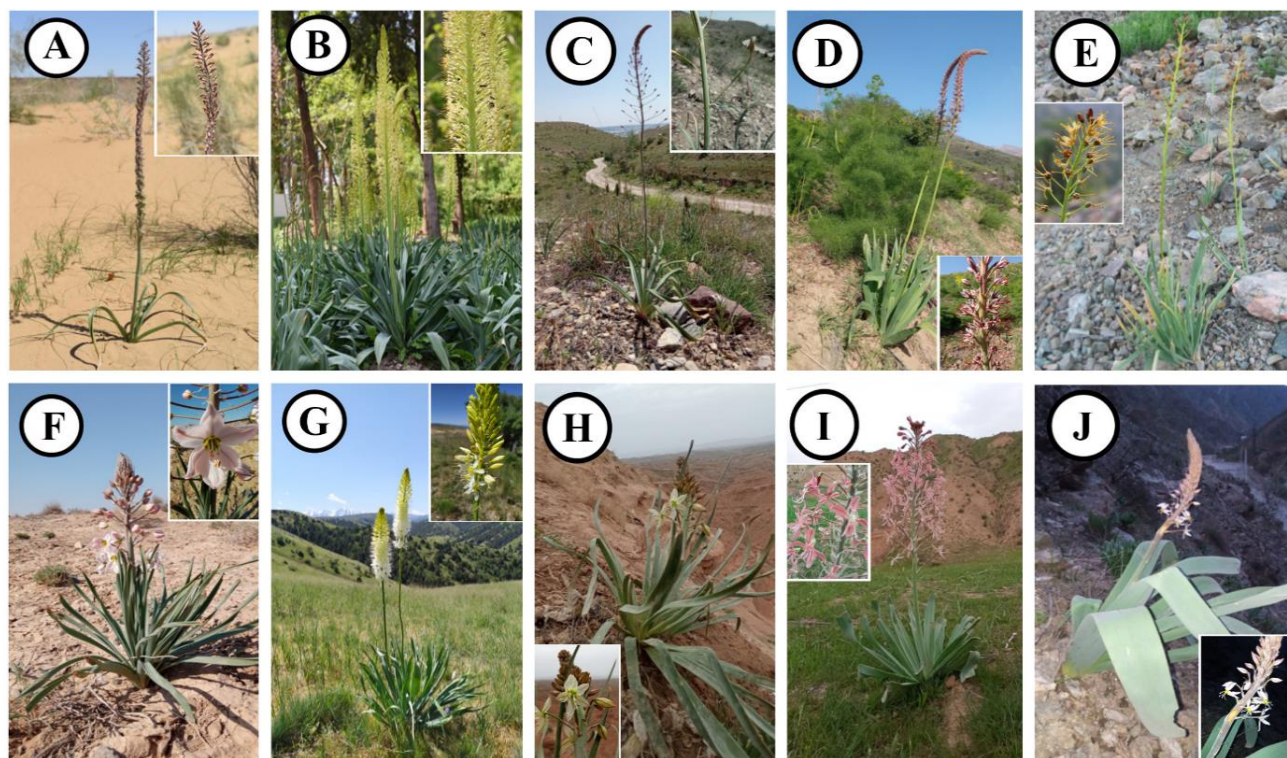


Fig. 1. Habitat and raceme of species of *Eremurus* studied: A: *Eremurus inderiensis*; B: *E. altaicus*; C: *E. soogdianus*; D: *E. regelii*; E: *E. iae*; F: *E. korolkowii*; G: *E. kaufmannii*; H: *E. baissunensis*; I: *E. alberti*; J: *E. pubescens*. Photo localities are given in Appendix 1.

Table 1. List of morphological characters used in phylogenetic analysis.

1. Height of plant: <70 cm (0) > 70cm (1)
2. Root thickness: < 7 mm (0) > 7 mm (1)
3. Scape: glabrous (0) pubescent at base (1) pubescent (2)
- Leaves:
4. Shape: narrowly linear (0) broadly linear (1)
5. Indumentum: glabrous (0) pubescent (1)
- Raceme:
6. Number of flowers: laxly flowered (0) densely flowered (1)
7. Length: <40 cm (0) > 40 cm (1)
8. Bract: subulate (0) lanceolate (1)
9. Pedicel: slightly shorter or 1.5–2 times as long as the perianth (0) more than 2 times longer (1)
10. Flower shape: subrotate (0) tubular (1) campanulate (2)
11. Number of veins per tepal: 1 vein (0) 3 or 5 veins (1)
12. Tepal color: white (0) pale pink, pink, or pale meat red (1) whitish yellow or bright yellow (2) buff, pinkish brown, or brown (3)
13. Stamens: shorter than perianth (0) longer than perianth (1)

Table 2. Data matrix used in cladistic analysis of *Eremurus* and four outgroup species. Missing data coded as “?”, Symbols = “0, 1, 2, 3”

Taxa	Characters
<i>Asphodeline tenuior</i> subsp. <i>tenuiflora</i> (K. Koch) Tuzlaci	000000000000
<i>Asphodelus tenuifolius</i> Cav.	0000000101000
<i>Eremurus roseolus</i> Vved.	0000?00110010
<i>Eremurus aitchisonii</i> Baker	1111000110010
<i>Eremurus alberti</i> Regel	1100011110010
<i>Eremurus altaicus</i> (Pall.) Steven	1001010002121
<i>Eremurus ambigens</i> Vved.	1120?10010020
<i>Eremurus ammophilus</i> Vved.	0010000110010
<i>Eremurus anisopterus</i> (Kar. & Kir.) Regel	0010000110010
<i>Eremurus baissunensis</i> O.Fedtsch.	0000?00110000
<i>Eremurus chloranthus</i> Popov	00010100100?0
<i>Eremurus comosus</i> O.Fedtsch.	1011110101111
<i>Eremurus fuscus</i> (O.Fedtsch.) Vved.	1001010002121
<i>Eremurus hiliariae</i> Popov & Vved.	1011110110000
<i>Eremurus hissaricus</i> Vved.	1001010002131
<i>Eremurus iae</i> Vved.	1001000002131
<i>Eremurus inderiensis</i> (M.Bieb.) Regel	1021010001111
<i>Eremurus kaufmannii</i> Regel	1111110010000
<i>Eremurus korolkowii</i> Regel	0010000110000
<i>Eremurus korovinnii</i> B.Fedtsch.	0010110110010
<i>Eremurus lachnostegius</i> Vved.	0001000010020
<i>Eremurus lactiflorus</i> O.Fedtsch	0001010110000
<i>Eremurus luteus</i> Baker	0000?00110020
<i>Eremurus nuratavicus</i> Khokhr.	1101011002111
<i>Eremurus olgae</i> Regel	1100010010010
<i>Eremurus parviflorus</i> Regel	1110000010000
<i>Eremurus pubescens</i> Vved.	1021111010010
<i>Eremurus regelii</i> Vved.	1101011002111
<i>Eremurus robustus</i> (Regel) Regel	1101011110010
<i>Eremurus soogdianus</i> (Regel) Benth. & Hook.f.	1110011012101
<i>Eremurus stenophyllus</i> (Boiss. & Buhse) Baker	1010011010021
<i>Eremurus suworowii</i> Regel	1110000010020
<i>Eremurus tianschanicus</i> Pazij & Vved. ex Pavlov	1110011010011
<i>Eremurus turkestanicus</i> Regel	1001000002101
<i>Trachyandra malosana</i> (Baker) Oberm.	0000000100000

Results

The strict consensus tree (CI= 0.465, RI= 0.878) of the cladistic analysis based on reweighted characters is shown in Fig. 2A. The four outgroup species formed a clade sister to *Eremurus*. Among the species of *Eremurus*

analyzed, all species had resolved branches, but bootstrap support was below 50 for the majority of the clades. Subgenera *Eremurus* and *Henningia* did not form two sister clades, although the species of *Eremurus* were clustered together. Within subgen. *Eremurus*, the two species representing sect. *Ammolirion* (Kar. et

Kir.) Boiss. formed a clade separated from the species comprising sect. *Eremurus*.

The ancestral state reconstruction analyses showed that subrotate flowers, tepals with one

abaxial nerve, and short stamens are ancestral (symplesiomorphies) (Fig. 3).

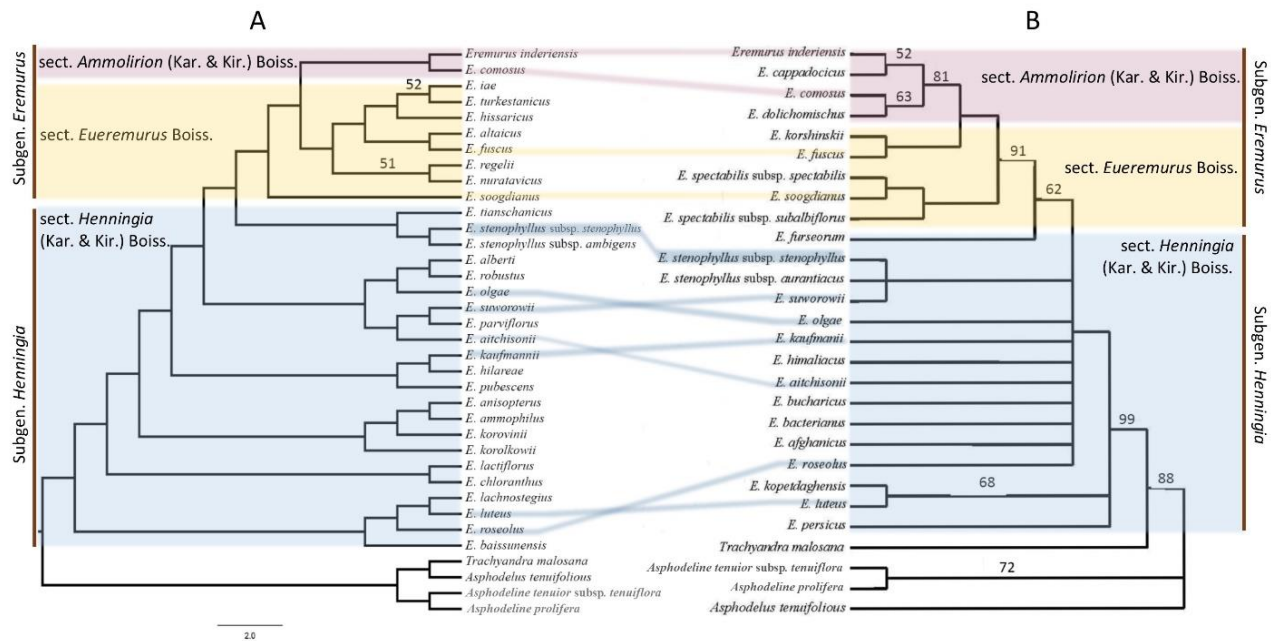


Fig. 2. A: Strict consensus tree produced by cladistic analysis of 13 morphological characters. B: Strict consensus tree from Nareri et al. (2009) produced using 25 characters. Numbers above branches are bootstrap values. Numbers <50% are not shown.

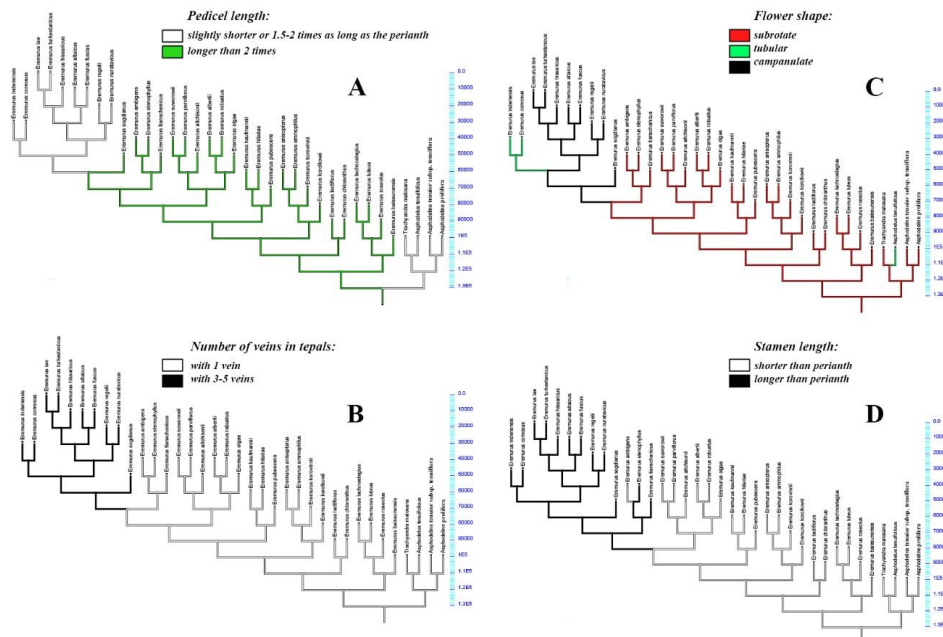


Fig. 3. Ancestral state reconstruction for four taxonomically important morphological characters used in the cladistic analysis.

Discussion

Infrageneric relationships of Eremurus

This study included 32 species of *Eremurus*. In contrast to online databases (<http://www.theplantlist.org>, <http://wesp.science.kew.org>) based on Khokhryakov's (1965) data we treat here *E. luteus* as the same as *E. capusii* and different from *E. baissunensis*. We also treat *E. anisopterus* and *E. korolkowii* as separate species due to morphological differences and different ecology. *Eremurus anisopterus* has a scape 25–70 cm long, white tepals and grows in deserts on moving and fixed sands; *E. korolkowii* has a scape 20–40 cm long, pinkish tepals and grows on bedrock outcrops.

Wendelbo (1982) divided *Eremurus* into two subgenera, *Eremurus* and *Henningia*. Subgenus *Eremurus* is composed of sections *Eremurus* and *Ammolirion* and is characterized by tubular and campanulate flowers and incurved tepals with 3 or 5 abaxial nerves (plesiomorphy). Section *Ammolirion* can be distinguished from section *Eremurus* by having tubular flowers rather than campanulate flowers (Wendelbo 1982) and by the thinner pollen exine (Kosenko 1999). In our study these two sections were separated better than in the methodologically similar study of Naderi et al. (2009). Subgenus *Henningia* has white, pink, or yellow subrotate flowers, included filaments and erect or recurved tepals with one abaxial nerve (Naderi et al. 2009). In the consensus tree (Fig.2.

A), as in Naderi et al. (2009) (Fig.2. B), the species of subgenus *Eremurus* were clustered together but did not form a distinct clade sister to *Henningia*.

Our cladistic analysis had obvious limitations due to limited geographic coverage. Lack of species from other regions can be one of the reasons why subgenus *Henningia* did not form a distinct clade. Deeper sampling is definitely needed for resolving the phylogeny of this section (and of the whole genus).

Key for identification and a synopsis of the species of Eremurus in Uzbekistan

A method that allows the accurate identification of species is of fundamental importance in plant systematics (Simpson 2010). A dichotomous key is a method commonly used for species identification and is typically available in many taxonomic revisions and local floristic treatments (Seo & Oh 2017). In the first taxonomic treatment of *Eremurus* for the flora of Uzbekistan, 20 species were treated (Vvedensky 1941). Below we provide a new key for the identification of the 32 species of *Eremurus* now recognized as growing in Uzbekistan.

The photos for the key were taken from <https://www.plantarium.ru>, the Red Data Book of the Republic of Uzbekistan (Tojibaev et al. 2019), and by the authors of this study. No photos were available for *E. parviflorus* and *E. ammophilus*.

Eremurus M.Bieb.

in Fl. Taur.-Caucas. 3: 269 (1819).

Type: *E. spectabilis* M. Bieb., [nom. cons.].

Plants rhizomatous; rhizome short, neck often covered with membranous or fibrillose remnants of old leaves; roots crowded, fleshy, cylindric or fusiform; leaves all radical, often numerous, linear-triangular, carinate beneath, narrow or broad, flat or canaliculate above; scape erect, simple, leafless, sometimes very tall. Flowering raceme elongate, bracts commonly

membranous; pedicels mostly jointed at the distally. Flowers: tepals white, rose, dingy red, yellow or brown, solitary in axils of bracts; perianth campanulate or cupuliform, withering and persistent or finally caducous; perianth segments distinct or connate at base, 1-nerved or 3- or 5-nerved (nerves more readily discernible on dried plants); stamens 6, hypogynous, sometimes exceeding the perianth; filaments

filiform or dilated toward base; anthers oblong to linear, dorsifixed near base; Ovary 3-celled; style filiform; stigma minute; capsule subglobose, membranous or subligneous, smooth or rarely cross wrinkled, 3-celled, loculicidally 3-valved; seeds 3 or 4, attached on either side of the septum, irregularly acutely triquetrous; with hard testa, often winged, wing

narrow or (especially in upper seeds in each division) broad.

Etymology. From Greek *eremos*, desert, and *ura*, tail, i.e., desert tail.

1. Perianth segments narrowly tubular or campanulate, 3- or 5-nerved, stamens longer than perianth.....**subgen. *Eremurus***
2. Perianth segments rotate, 1-nerved, stamens included**subgen. *Henningia***

Subgen. *Eremurus*

1. Perianth narrowly campanulate or tubular-campanulate, scarcely inflexed apically; filaments barely exerted..... **sect. *Ammolirion***
2. Perianth campanulate, immediately incurved at apex, filaments exerted**sect. *Eremurus***

Sect. *Ammolirion* (Kar & Kir) Boiss.

Fl. Or. 5: 322 (1882). — *Ammolirion* Kar. & Kir. in Bull. Soc. Imp. Naturalistes Moscou 15(2): 515 (1842).

Type: *E. indierensis* (M. Bieb.) Regel

1. Flowers narrowly tubular-campanulate; bracts usually longer than pedicels, margins finely ciliate(1) ***E. indierensis***



2. Flowers narrowly campanulate; bracts before flowering much longer than buds, at anthesis half as long as pedicel, margin long ciliate, cilia forming a dense white tuft apically(2) ***E. comosus***



(1) *Eremurus indierensis* (M. Bieb.) Regel

in Gartenflora 22: 259 (1873). — *Eremurus spectabilis* f. *indierensis* M. Bieb. in Fl. Taur.-Caucas. 3: 270 (1819). — *Asphodelus indierensis* (M. Bieb.) Steven in Bull. Soc. Imp. Naturalistes Moscou 4: 257 (1832). — *Ammolirion indierense* (Steven) Regel ex A.P. Khokhr., Erem. Cult.: 65 (1965).

Type: Kazakhstan. Inderskie Mountains, on left bank of Ural River (holotype LE).

= *Eremurus velutinus* Boiss. & Buhse in Nouv. Mem. Soc. Imp. Naturalistes Moscou 12: 217 (1860). — *Ammolirion velutinum* (Boiss. & Buhse) Khokhr., Erem. Cult.: 66 (1965).

Type: Iran. Mountains between Yazd and Isfahan in the valley of Gasnabad, May 12, 1819. no.1423. (holotype unknown).

= *Eremurus pauciflorus* Baker in J. Bot. 17: 18 (1879).

Type: Iran, near Eschrebad, 7.05.1859, Bunge (holotype unknown).

Scape (25)50–80(120) cm tall, more or less shaggy-fluffy, usually stocky, (3)8–15(25) mm

thick. Roots slightly fusiform thickened, 4–8 mm thick, up to 30 cm long; neck densely

surrounded by the remains of old leaves. Leaves broadly linear, outer (5–)8–15(–25) mm wide, grooved, keeled, glaucous, naked or less often fluffy. Raceme loose, multi-flowered, cylindrical (8)20–40(70) cm long. Bracts triangular-lanceolate, long drawn, shaggy-ciliated, membranous, finely ciliated, longer than pedicels, with a dark keel. Pedicels slightly bent outward, often pubescent, slightly shorter or slightly longer than the perianth, articulated, straight ascending almost pressed against the stem. Perianth narrowly campanulate; cylindrical-bell shaped, tapering at base, green or dirty purple. Tepal lobes with a wide greenish stripe, veins (especially on the inner lobes) close, with 3–5 veins, narrow, obtuse, pinkish, dirty-green abaxially, sometimes pubescent, 10–12 mm long, linear lanceolate, after flowering barely curling at the top and sticking together in

a cap, discarded by the developing fruit. Stamens slightly longer than perianth, filaments greenish brown. Capsule spherical, smooth valves, 7–10 mm wide. Seeds narrowly winged, 3 or 4 in the nest, gray, 6 mm long, cut through by perpendicular thick dark veins. Fig. 4.

Flowering: April-May.

Fruiting-May-June.

Ecology: On sandy, less often clayey substrates in the desert, in the lower zone of mountains (Fig. 4).

General distribution: Afghanistan, East European Russia, Iran, Mongolia, Pakistan, West Siberia, China, Central Asia (Northern and Southern deserts, Southern Pamir-Alay, Western Kopet-Dag): Kazakhstan; Kyrgyzstan, Tajikistan, Turkmenistan, Uzbekistan.

Distribution in Uzbekistan: suppl. file 1.

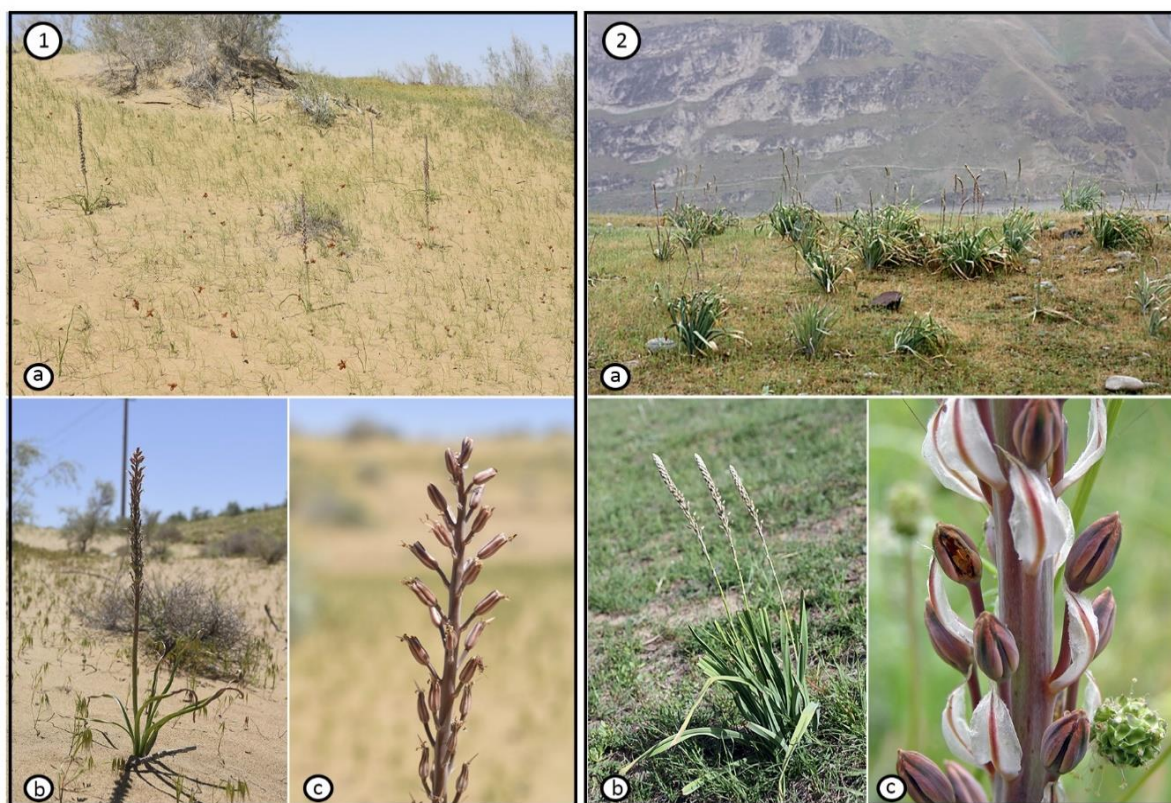


Fig. 4. 1- *Eremurus inderiensis*, 2- *Eremurus comosus*, a: habitat, b: general appearance, c: inflorescence. Photos by Evgeniy Davkaev, Alim Gaziev, www.plantarium.ru.

(2) *Eremurus comosus* O. Fedtsch.

in Bull. Herb. Boissier, ser. 2, 4: 772 (1904). — *Ammolirion comosum* (O. Fedtsch.) Khokhr., Erem. Cult.: 67 (1965).

Type: Tajikistan. Hissar district, Faisabad, on the slopes of the mountains, 23.05. 1897, Korshinsky 795, 796 (holotype LE).

Scape (50) 70–100 (120) cm tall, slender, seated with numerous bracts, protruding short-haired below, slender. Roots 5–9 mm thick, weakly fusiform. Neck with few sheaths. Leaves broadly linear, outer (0.6) 1–1.5 (3) cm wide, grooved, keeled, fluffy, glaucous. Raceme 5–50 cm long, loose, rather dense, narrow. Bracts large, broadly lanceolate, acute, shaggy-ciliated, equal to or slightly shorter than pedicels, the uppermost ones, due to the shortening of internodes and underdevelopment of flowers, form a crest; papery, glabrous, long ciliated along the margin, broadly lanceolate, white, with a dark longitudinal stripe, much longer than buds before flowering, forming a dense white crest at the apex of the spike; during flowering, the bracts are half as long as the pedicels. Pedicels slightly deflected, 1.5–2 times as long as the perianth; directed upwards at a very acute angle, slender, slightly widened

upwards, with indistinct articulation. Perianth narrowly campanulate. Tepals greenish-pink, slightly curled inward; with 3–5 dirty green veins, 0.8–1.1 cm long, linear-lanceolate, after flowering slightly curled at the top and sticking together into a cap, discarded by the developing fruit. Stamens slightly longer than the perianth, with reddish filaments. Capsule spherical, naked, smooth, 1.2–1.7 cm wide. Seeds winged. Fig. 4.1.

Flowering: May–July.

Fruiting: June–July.

Ecology: On loess and stony slopes in the middle mountain zone. (Fig. 4.2).

General distribution: Afghanistan, Central Asia (Pamir-Alay, Alay Range): Kyrgyzstan, Tajikistan, Uzbekistan.

Distribution in Uzbekistan: suppl. file 2.

Sect. *Eremurus*

Type: *E. spectabilis* M. Bieb.

— *Selonia* Regel in Bull. Soc. Nat. Mosc. 41, 1: 457 (1868).

Type: *Selonia soogdiana* Regel.

- 1a. Tepals subequal.....2
- 1b. Tepals unequal.....3
- 2a. Capsule cross wrinkled.....4
- 2b. Capsule smooth.....5
- 3a. Outer tepals obanceolate, with a yellowish greenish stripe, almost 2 times narrower than the deltoid inner ones, white, with a thin, yellowish greenish stripe..... (1) *E. soogdianus*



- 3b. Basal part of outer tepals 1.5 times narrower than deltoid inner ones, pale pinkish, with a wide, brownish purple stripe.....(2) *E. nuratavicus*



- 4a. Tepals pale pink with a brownish purple stripe abaxially.....(3) *E. regelii*



- 4b. Tepals light buff or light pinkish brown, with a greenish stripe abaxially(4) *E. hissaricus*



- 5a. Tepals with yellowish green or green stripe.....6

- 5b. Tepals with brownish purple stripe.....(5) *E. iae*



- 6a. Pedicels appressed to the inflorescence axis, thickened under the flower, without noticeable articulation.....(6) *E. turkestanicus*



- 6b. Pedicels slightly deflected, not thickened under the flower, with a clear articulation.....7

- 7a. Tepals pale yellow, not turning brown after flowering.(7).....*E. altaicus*



- 7b. Tepals whitish or yellowish green abaxially, turning brown very quickly.....(8) *E. fuscus*



(1) *Eremurus soogdianus* (Regel) Benth. & Hook.f.

Gen. Pl. 3: 787 (1883). — *Selonia soogdiana* Regel in Bull. Soc. Imp. Naturalistes Moscou 41(1): 458, t. 8 (1868).

Type: Kazakhstan. Karatau, near Boroldai, May, Sewerzow (holotype LE).

Scape (20)50–80(150) cm tall, at the base rough-fluffy. Roots fusiform thickened, 5–8 mm thick. Leaves narrowly linear, the outer leaves are 4–7(15) mm wide, grooved, keeled, glabrous, ciliate. Raceme very loose, usually many-flowered, conical, (10)30–40(70) cm long. Bracts from a triangular base drawn, ciliate. Pedicels green, at the bottom of the

inflorescence they are 5 or more times longer than the perianth, horizontally deflected. Tepals with 3 veins, white with a green stripe, 1–1.4 cm long, after flowering inwardly wrapped; the outer ones are obverse-lanceolate, the inner ones are deltoid, almost twice wider than the outer ones. Stamens slightly longer than the perianth, with brownish filaments. Capsule spherical,

smooth, glabrous, 6–7 mm wide. Seeds very narrowly winged. Fig. 5.

Flowering: May-June.

Fruiting: June-July.

Ecology: In semi-savannah desert, shiblyak and thermophilic juniper forests, steppes and cryophilic juniper forests, often in rose gardens,

on talus, rocky slopes; altitude 950–2600 m (Fig. 5).

General distribution: Afghanistan, Central Asia (Pamir-Alay, Tien Shan): Kazakhstan, Kyrgyzstan, Tajikistan, Uzbekistan.

Distribution in Uzbekistan: suppl. file 3.



Fig. 5. 1- *Eremurus soogdianus*, a: habitat, b: general appearance, c: inflorescence. Photos by Alim Gaziev, Natalia Beshko, www.plantarium.ru.

(2). *Eremurus nuratavicus* Khokhr.

Erem. Cult.: 73 (1965).

Type: Uzbekistan. Samarkand, distr. Farish, near the village of Michajam, 18.05.1961, A. Khochrjakov (holotype MW).

Peduncle 40–120 cm long, leaves 10–30 mm wide, glabrous, inflorescence sparse, tepals 8–11 mm long, bracts white, 12–14 mm long, pedicels 10–15 mm long. It is very closely related to the *Eremurus regilius* Vved., but differs from the loose race with white bracts and liniform roots. In the higher parts of the Nuratau Mountains. Apparently, a narrow endemic. Fig. 6.

Flowering: May.

Fruiting: July.

Ecology: On rocky slopes in the lower zone of the mountains.

General distribution: Central Asia (Pamir-Alay: Nuratau range): Uzbekistan.

Distribution in Uzbekistan: suppl. file 4.



Fig. 6. *Eremurus nuratavicus*. Photos by Natalia Beshko.

3) *Eremurus regelii* Vved.

in Trudy Sredne-Aziatsk. Gosud. Univ., Ser. 8b, Bot. 3: 3 (1928). — *Eremurus spectabilis* subsp. *regelii* (Vved.) Wendelbo in Fl. Iranica 151: 15 (1982).

Described from Pamir-Alay and Tian Shan.

Scape glabrous, 80–150 cm. Roots fusiform thickened, 7–10 mm thick. Leaves broadly linear, outer 2.5–5 cm wide, grooved, keeled, glaucous, glabrous, along the margin and keel, rough-ciliate. Raceme dense, many-flowered,

cylindrical, 30–60 cm long. Bracts triangular, long drawn out, shaggy-ciliate. Pedicels brownish purple, up to 1.5 times longer than perianth, lower ones less of slightly shorter than perianth, bent outward during flowering,

arcuately curved with fruits, with capsules, pressed to the axis of the inflorescence. Tepals with 3 veins, pale pinkish, with a wide, brownish purple stripe, lanceolate, almost equal, 1.2–1.4 cm long, after flowering inwardly curled. Stamens almost 1.5 times as long as the perianth, with brown filaments. Capsule spherical, transversely wrinkled, 6–8 mm wide. Seeds very narrowly winged. Fig. 7.

Flowering: April–June.

Fruiting: May–July.

Ecology: On the lower slopes from the foothills to the middle zone of mountains; altitude 1000–3000 m (Fig. 7).

General distribution: Afghanistan, Central Asia (Pamir-Alay, Tien Shan): Kazakhstan, Kyrgyzstan, Tajikistan, Uzbekistan.

Distribution in Uzbekistan: suppl. file 5.

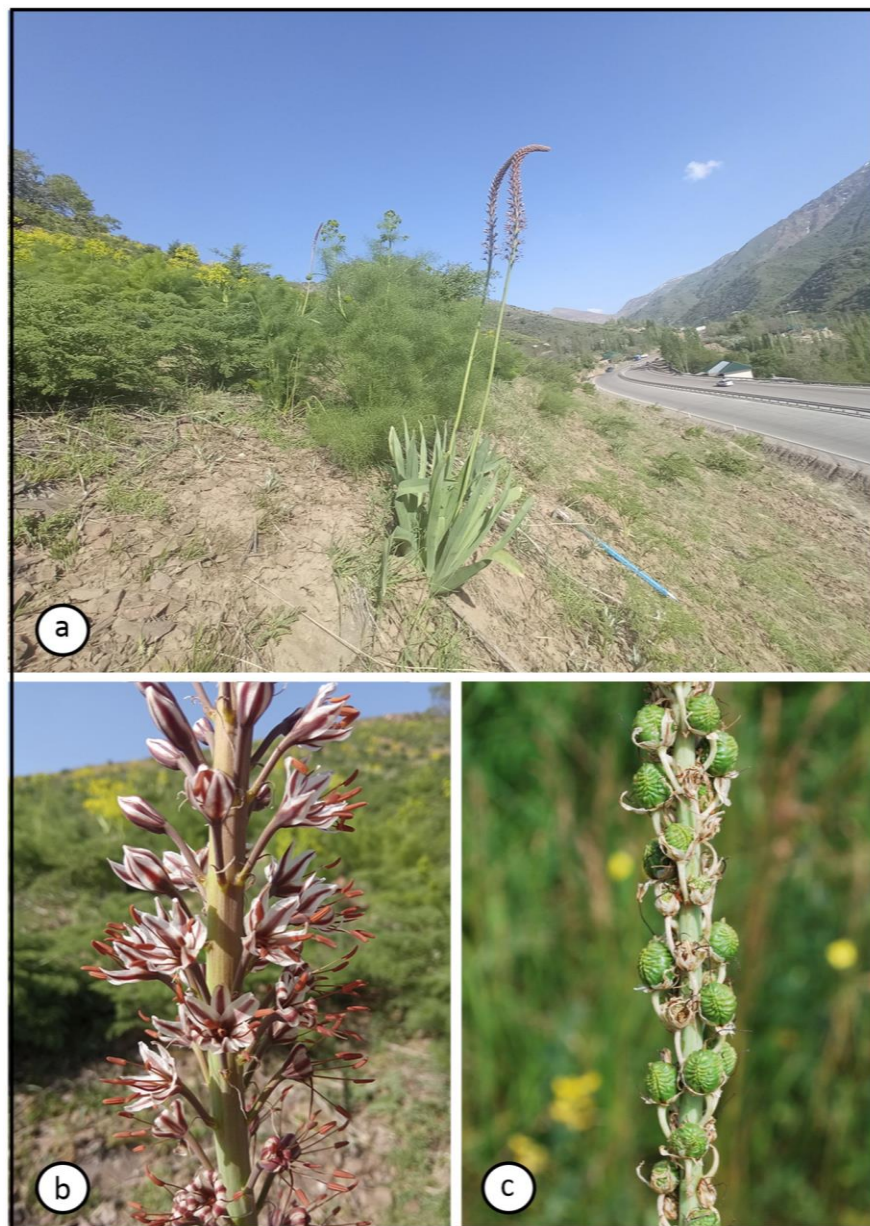


Fig. 7. *Eremurus regelii*, a: habitat, b: inflorescence, c: capsule. Photos by Tulkin Tillaev, www.plantarium.ru.

(4) *Eremurus hissaricus* Vved.

in Bot. Mater. Gerb. Bot. Inst. Komarova Akad. Nauk S.S.S.R. 9: 233 (1946).

Type: Grown in the experimental department of Botanical Garden of the Central Asian State University under no. 56 from rhizomes collected by Mironov and Pazyi in 1930 in the eastern part of the Gissar Range, 05.12.1936. (holotype TASH).

= *Eremurus pectiniformis* Rjabov in Novosti Sist. Vyssh. Rast. 1968: 37 (1968).

Type: Uzbekistan. Pamir-Alay, Zeravschan ridge, the Takhta-Karacha pass, alt. 1600 m., In the Botanical Garden of the Botanical Institute of Acad. Sci. planted RSS Tajikistan (Duschanbe), 28.04.1959, T. Rjabova. (holotype LE).

Scape 100–180 cm tall, glabrous. Roots fusiform thickened, 4–7 mm thick. Leaves broadly linear, outer 1.5–2.5 cm wide, bluish or glaucous, grooved, keeled, glabrous, scabrous-ciliated along the margin and keel. Raceme dense, cylindrical, 20–60 cm long. Bracts triangular, long drawn, shaggy-ciliated. Pedicels green, the lower ones are slightly shorter or slightly longer than the perianth, slightly deflected during flowering, slightly arcuate with fruits, more or less pressed to the inflorescence axis. Tepals with 3 veins, 1.2–1.4 cm long, light buffy or light pinkish brown, greenish abaxially, brownish after flowering, curled inward. Stamens 1.5 times as long as the perianth, with reddish

brown, later purple-brown filaments. Ovary greenish, wrinkled. Capsule spherical, slightly transversely wrinkled, 7–9 mm wide. Seeds narrowly winged. Fig. 8.

Flowering: June–August.

Fruiting: July–September.

Ecology: On stony slopes in the middle zone of mountains, mainly in the upper part of the black forests, in juniper forests; altitude (2000)2600–3000 m. (Fig. 8).

General distribution: Central Asia (Pamir-Alay: Gissar and Zarafshan ranges): Tajikistan, Uzbekistan.

Distribution in Uzbekistan: suppl. file 6.



Fig. 8. *Eremurus hissaricus*, a: habitat, b: general appearance, c: flower. Photos by Natalia Beshko, www.plantarium.ru.

(5) *Eremurus iae* Vved.

in Fl. Uzbekistan. 1: 541 (1941).

Type: On the clayey-rocky northern slopes of the Tschulbair mountains above the village of Sina, 03.06.1929, Vvedensky 676. (holotype TASH).

Scape 60–80(100) cm tall, glabrous. Roots slightly thickened, 3–4(5) mm thick, numerous. Leaves broadly linear, outer 15–20 mm wide, grooved, keeled, glaucous, glabrous. Raceme sparse, few flowered, cylindrical, 20–30(40) cm long. Bracts narrowly triangular, long drawn,

weakly ciliated. Pedicels green, lower ones twice as long as the perianth, strongly deflected. Tepals with 3–5 veins, brownish pinkish with a wide brownish purple stripe, lanceolate, 11–12 mm long, after flowering curled inward, brownish at the ends. Stamens almost 1.5 times

as long as the perianth, with brown filaments. Capsule spherical, smooth, large (over 1 cm). Fig. 9.

Flowering: May-June.

Fruiting: June-July.

Ecology: On stony-clayey, mainly northern slopes in the middle zone of mountains (Fig. 9).

General distribution: Surkhandarya region (Chulbair). A rare plant. Endemic.

General distribution: Central Asia (Pamir-Alay: Chulbair mountain): Uzbekistan. Endemic.

Distribution in Uzbekistan: suppl. file 7.

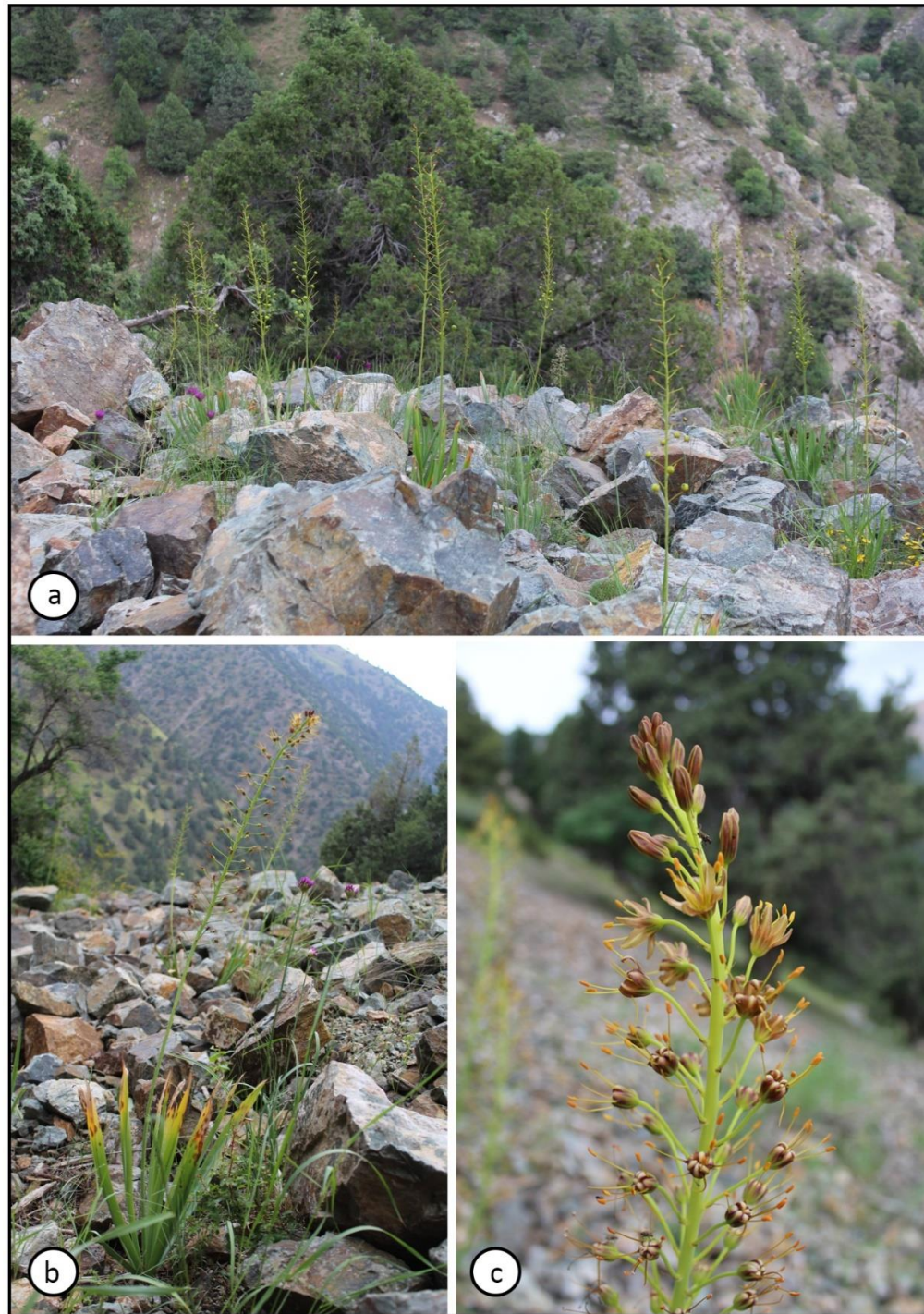


Fig. 9. *Eremurus iae*, a: habitat, b: general appearance, c: inflorescence. Photos by the authors.

(6) *Eremurus turkestanicus* Regel

in Acta Horti Petrop. 2:424 (1873); Gartenflora 22: 260 (1873). — *Selonina turkestanica* (Regel) A.P. Khokhr., Erem. Cult.: 69 (1965).

Type: Basmandinskoe Ravine, O.Fedschenko (holotype LE).

Scape 50–120 cm tall, glabrous, up to 8 mm thick. Roots fusiform thickened, 4–7 mm thick, up to 18 cm long. Leaves broadly linear, outer 20–30(45) mm wide, grooved, glaucous, glabrous, smooth, belt-like belt-shaped or lancet-oblong, keeled on the underside, slightly pointed, narrowed towards the base, 0.8–2 cm wide. Raceme loose, sparse, relatively few-flowered, narrowly cylindrical, 30–50 cm long. Bracts from triangular base, long drawn, ciliated; linear, extending from the widened base, woolly-ciliated along the margin. Pedicels inflorescences almost pressed to the axis, thickened under the flower, without noticeable articulation, the lower ones are almost twice longer than the perianth. Perianth campanulate. Tepals with 3 closely spaced veins, whitish with a green stripe, linear-lanceolate, 9–12 mm long,

almost equal, after flowering inwardly curled, brown at the ends, inner lobes are wider, white, with a yellowish green vein in the middle; in the dry form 5 veins are on the outer lobes, 3 stripes on the inner lobes. Stamens slightly longer than the perianth with brownish purple filaments. Ovary green, smooth, triangular. Capsule spherical, smooth, rounded-angular, pointed upwards 7–8 mm wide. Seeds triangular, wrinkled, gray, narrowly winged. Fig. 10.

Flowering: April–July.

Fruiting: July–August.

Ecology: On stony-clayey slopes in the middle zone of mountains. (Fig. 10).

General distribution: Central Asia (Pamir-Alay, Tien Shan): Kazakhstan, Kyrgyzstan, Tajikistan, Uzbekistan.

Distribution in Uzbekistan: suppl. file 8.

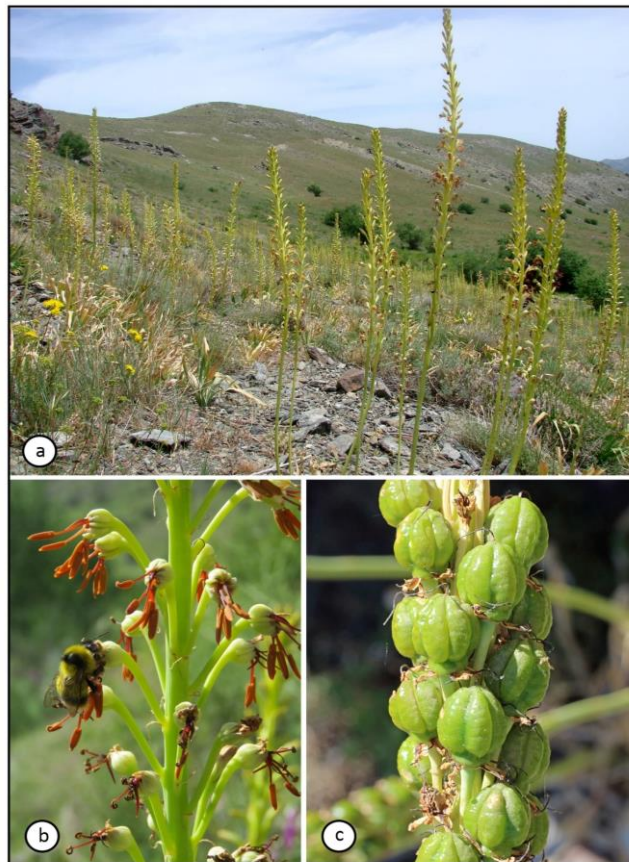


Fig. 10. *Eremurus turkestanicus*, a: habitat, b: inflorescence, c: capsule. Photos by Natalia Beshko, Alim Gaziev www.plantarium.ru.

(7) *Eremurus altaicus* (Pall.) Steven

in Bull. Soc. Imp. Naturalistes Moscou 4: 255 (1832). — *Asphodelus altaicus* Pall. in Acta Acad. Sci. Imp. Petrop. 2: 258 (1779).
Type: Kazakhstan. Altai foothills, along the Uba River, a tributary of the Irtysh. (holotype G).

Scape 50–100(150) cm tall, naked, cylindrical, sometimes reddish brown. Roots fusiform-thickened, 5–8 mm thick, up to 20 cm long. Neck with few fibers from old leaves and membranous sheaths. Leaves broadly linear, outer 15–20(40) mm wide, grooved, keeled, glaucous, naked, belt-shaped, smooth or rough along the margin. Raceme dense, multi-flowered, cylindrical, 20–40(70) cm long. Bracts from a wide base linear-filiform, shaggy-ciliated, narrowly triangular-lanceolate, long drawn. Pedicels yellow, with an articulation at the top, peduncles much longer, horizontally spaced; slightly deviated green, lower ones 1.5–2 times longer than the perianth. Perianth narrowly bell-shaped (campanulate). Tepals with 3 closely spaced veins, whitish, yellowish, non-brownish, green abaxially,

reddish brown at the apex, 9–12 mm long, after flowering inwardly curled; external linear-lanceolate, internal lanceolate. Stamens slightly longer than the perianth, with brownish filaments. Anthers yellow. Capsule spherical, smooth, 7–12(14) mm wide. Seeds triangular or irregularly tetrahedral, dark, very narrowly winged; sharp ribbed, almost wingless. Fig. 11.

Flowering: May–June.

Fruiting: June–July.

Ecology: On rocky-clay slopes in the middle zone of mountains.

General distribution: China, Russia, Central Asia (Pamir-Alay, Tien Shan): Kazakhstan, Kyrgyzstan, Tajikistan, Uzbekistan.

Distribution in Uzbekistan: suppl. file 9.



Fig. 11. *Eremurus altaicus*, a: general appearance, b: inflorescence, c: flower. Photos by the authors

(8) *Eremurus fuscus* (O. Fedtsch.) Vved.

in Bot. Mater. Gerb. Inst. Bot. Akad. Nauk Uzbeksk. S.S.R. 13: 27 (1952).

Grown in the experimental department of the Botanical Garden of Central Asian State University from rhizomes collected by Z. P. Bochanieva in 1933, in the valley of the river Aubek (Ferghana Ridge) above apiary no. 12 of the collective farm "Krasvy Pakhar". (holotype TASH).

Scape 60–100(170) cm tall, glabrous. Roots fusiform thickened, 3–8 mm thick. Leaves broadly linear, outer 1–4 cm wide, grooved, keeled, glaucous, naked or rough along the margin, linear, smooth. Raceme dense, multi-flowered, cylindrical, 15–50(70) cm long. Bracts triangular base long drawn, shaggy-ciliated. Pedicels slightly deviated, green, the lower ones are 1.5–2 times longer than the perianth, with fruits erect, nearly appressed to inflorescence axis. Tepals with 3 closely spaced veins, whitish or yellowish, green abaxially, reddish brown at the apex, 9–13 mm long, after flowering brownish, inwardly curled, external linear-lanceolate, internal lanceolate. Stamens slightly

longer than the perianth, with brownish filaments. Capsule spherical, smooth, 0.8–1.2(1.5) cm wide. Seeds narrowly winged. Fig. 12.

Flowering: June–July.

Fruiting: July–August.

Ecology: In the middle and lower parts of the upper zone of mountains; altitude 2000–3000 m (Fig. 12).

General distribution: China, Pakistan, Russia, Central Asia (Pamir-Alay, Tien Shan): Kazakhstan, Kyrgyzstan, Tajikistan, Uzbekistan.

Distribution in Uzbekistan: suppl. file 10.

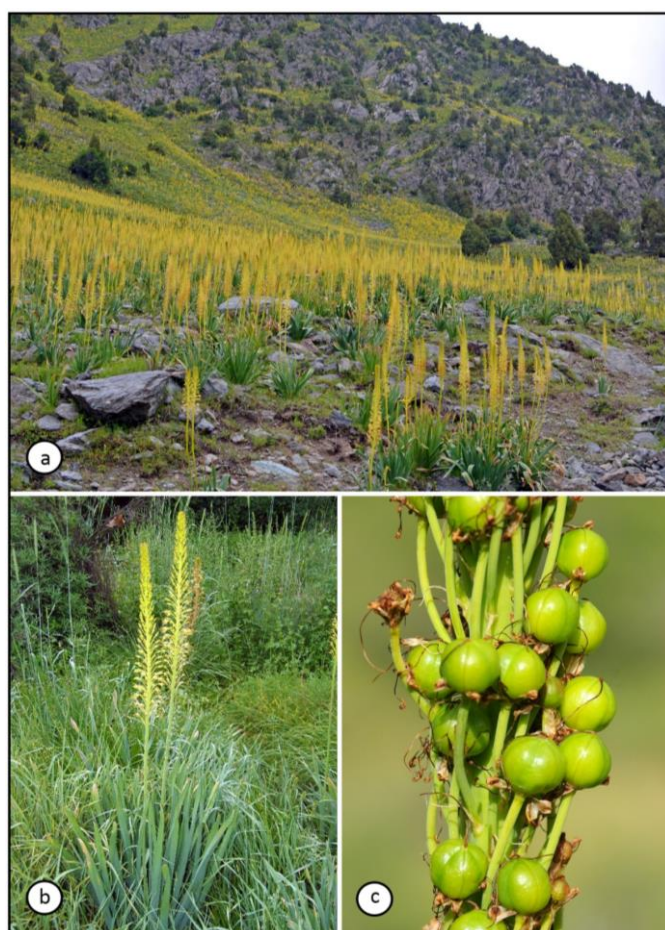


Fig. 12. *Eremurus fuscus*, a: habitat, b: general appearance, c: capsule. Photos by Pavel Gorbunov, Alim Gaziev, Vladimir Epiktetov, www.plantarium.ru.

 Subgen. *Henningia* (Kar. & Kir.) Baker,

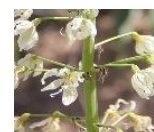
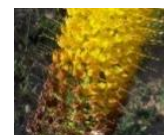
in J. Linn. Soc. Bot. 15: 279 (1877). —*Henningia* Kar. & Kir. in Bull. Soc. Nat. Mosc. 15: 516 (1842).

 Sect. *Henningia* (Kar. & Kir.) Boiss.

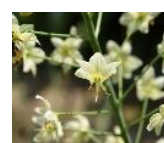
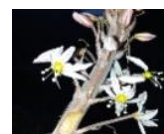
in Fl. Or. 5: 322 (1882).

Type: *Eremurus anisopterus* (Kar. & Kir.) Regel

- 1a. Tepals golden yellow, turning brown after flowering.....2
- 1b. Tepals white, greenish, slightly yellowish or pale fleshy red, never turning brown after flowering.....3
- 2a. Stamens almost 2 times as long as the perianth. Leaves glabrous.....(1) *E. stenophyllus* subsp. *stenophyllus*
- 2b. Stamens slightly longer than the perianth. Leaves pubescent.....(2) *E. stenophyllus* subsp. *ambigens*
- 3a. Bracts black.....(3) *E. lachnostegius*
- 3b. Bracts light colored.....4
- 4a. Tepals greenish.....(4) *E. chloranthus*
- 4b. Tepals white, yellow, pink or pale fleshy red.....5
- 5a. Capsule with 3 convex locules, 20-30 mm wide.....6
- 5b. Capsule spherical or elongated, round in cross section, 8-30 mm wide....8
- 6a. Tepals pale fleshy red, obversely lanceolate or obversely oblong, long drawn towards the base.....(5) *E. alberti*
- 6b. Tepals white or slightly yellowish, lanceolate or oblong.....7
- 7a. Tepals pure white. Leaves green, shiny, smooth.....(6) *E. lactiflorus*
- 7b. Tepals slightly yellowish. Leaves glaucous, scabrous.....(7) *E. hilariae*
- 8a. Capsule elongate.....9



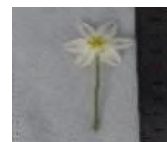
- 8b. Capsule spherical.....10
- 9a. Tepals yellow.....(8) *E. luteus*
- 9b. Tepals white.....(9) *E. baissunensis*
- 10a. Leaves fuzzy, slightly pubescent11
- 10b. Leaves glabrous and smooth, scabrous only along margin.....17
- 11a. Stem throughout and pedicels and veins of tepals pubescent
.....(10) *E. pubescens*
- 11b. Stem glabrous or pubescent only basally; pedicels and tepals glabrous....12
- 12a. Tepals white.....13
- 12b. Tepals light yellow or pink.....16
- 13a. Raceme dense.....(11) *E. kaufmannii*
- 13b. Raceme lax.....14
- 14a. Tepals 9-11 mm.....(12) *E. parviflorus*
- 14b. Tepals 15-19 mm.....15
- 15a. Inner tepals ovoid, stamens of equal length.....(13) *E. anisopterus*
- 15b. Inner tepals elliptic, stamens of unequal length.....(14) *E. ammophilus*
- 16a. Tepals light yellow.....(15) *E. suworovii*
- 17a. Leaves glabrous or short scabrous- tomentose.....18
- 17b. Leaves pubescent.....19
- 18a. Raceme (especially noticeable at the beginning of flowering)
conical.....(16) *E. olgae*
- 18b. Raceme cylindrical.....20



- 19a. Bracts triangular. Lower pedicels 1.5 times as long as perianth.....(17) *E. korovinii*



- 19b. Bracts narrowly triangular. Lower pedicels 2 times as long as perianth.....(18) *E. roseolus*



- 20a. Stamens slightly longer than tepals. Bracts gradually filiform from base, usually sparsely curly ciliate.....(19) *E. tianschanicus*



- 20b. Stamens shorter than tepals.....21

- 21a. Plants, 25-50-(70) cm tall. Outer leaves less than 10 mm wide(20) *E. korolkowii*



- 21b. Plants (70)-100-200 cm tall. Outer leaves less than 30 mm long22

- 22a. Leaves bright green, almost flat, abaxially winged(21) *E. aitchisonii*



- 22b. Leaves glaucous, abaxially grooved(22) *E. robustus*



(1) *Eremurus stenophyllus* (Boiss. & Buhse) Baker

in J. Linn. Soc., Bot. 15: 281 (1876). — *Ammolirion stenophyllum* Boiss. & Buhse in Nouv. Mem. Soc. Imp. Naturalistes Moscou 12: 218 (1860). — *Henningia stenophylla* (Boiss. & Buhse) A.P. Khokhr., Erem. Cult.: 93 (1965).

Type: Iran. Albus mountains in dry valleys between Ask and Firuskah, 26.06.1848, no. 1009. (holotype LE).

Scape (50)70–100(150) cm tall, at the base rough-fluffy, less often glabrous, cylindrical, 3–4 mm thick. Roots fusiform thickened, 3–10 mm thick, markedly narrowed towards the base. Neck densely surrounded by remnants of old leaves and membranous sheaths. Leaves narrowly linear, outer 4–7(10) mm wide, grooved, keeled, glaucous, glabrous. Raceme very dense, multi-flowered, cylindrical, (10)20–40(70) cm long, up to 4.5 cm in diameter. Bracts from triangular base almost filiform, usually

glabrous, subulate-filiform, half as long as pedicels. Pedicels horizontally deviated, the lower ones are usually equal to the perianth or less often longer than it. Perianth wide-campanulate. Tepals with 1 vein, golden yellow, brown after flowering, 9–12 mm long, oblong, outer slightly narrower than inner. Stamens yellow, almost twice as long as tepals. Style yellow. Ovary smooth, yellow. Anthers orange. Capsule spherical, smooth, 5–8 mm wide. Seeds

narrowly winged, small, not pressed to the apex.
Fig. 13.

Flowering: June-July.

Fruiting: July-August.

Ecology: on stony slopes in the middle mountain

zone; altitude 1600–2500(3000) m (Fig. 13).

General distribution: Afghanistan, Iran, Pakistan, Russia, Central Asia: Kyrgyzstan, Tajikistan, Turkmenistan, Uzbekistan.

Distribution in Uzbekistan: suppl. file 11.

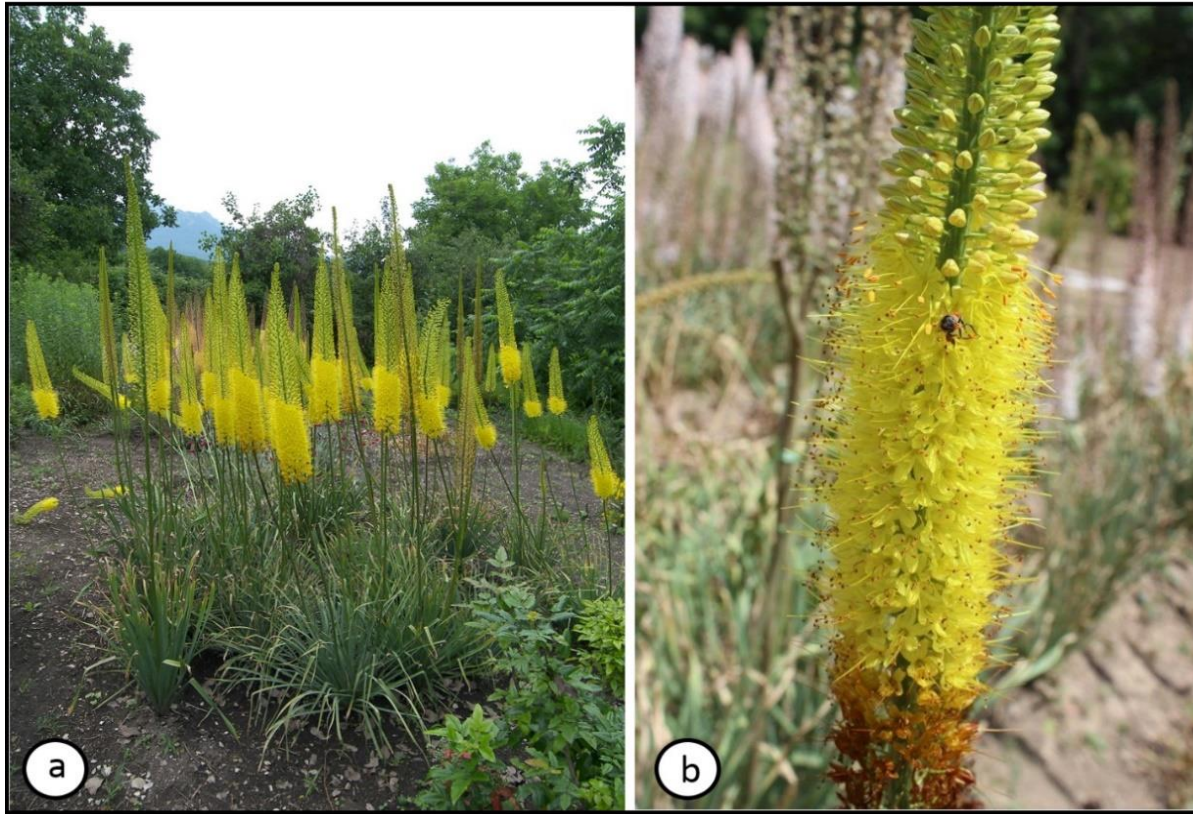


Fig. 13. *E. stenophyllus* subsp. *stenophyllus*, a: habitat and general appearance, b: inflorescence. Photos by Sergei Banketov.

(2) *Eremurus stenophyllus* subsp. *ambigens* (Vved.) Wendelbo

in Fl. Iranica 151: 28 (1982). — *Eremurus ambigens* Vved. in Fl. Uzbekistan. 1: 404 (1941). — *Eremurus stenophyllus* var. *pilosus* O. Fedtsch. in Zap. Imp. Akad. Nauk Fiz. -Mat. Otd., ser. 8, 23(8): 73 (1909). — *Henningia ambigens* (Vved.) A.P. Khokhr., Erem. Cult.: 93 (1965).

Type: Tajikistan. Kurgan-Tybe, 19.04.1906, G. Morren. (holotype LE).

Scape (25)40–60(80) cm., rough-fluffy. Roots fusiform-thickened, 6–9 mm thick. Leaves numerous, narrowly linear, outer 4–7 mm wide, triangular, along the margin and keel, and usually rough along the nerves. Raceme dense, many-flowered, cylindrical, 6–35 cm long. Bracts narrowly linear-triangular, gradually narrowed from the base, slightly ciliated. Pedicels horizontally deviated, the lower ones are equal to or 1.5 times as long as the perianth. Tepals pale yellow, slightly brown after flowering, 10–13 cm long, outer lanceolate,

almost 2 times narrower than inner oblong. Stamens slightly longer than the perianth. Capsule spherical, smooth, (7)9–10 mm wide. Seeds narrowly winged on the surface winged-lumpy. Fig. 14.

Flowering: April-May.

Fruiting: May-June.

Ecology: In semi-desert areas; altitude 350–600 m.

General distribution: Afghanistan, Central Asia (Pamir-Alay): Tajikistan, Uzbekistan.

Distribution in Uzbekistan: suppl. file 12.

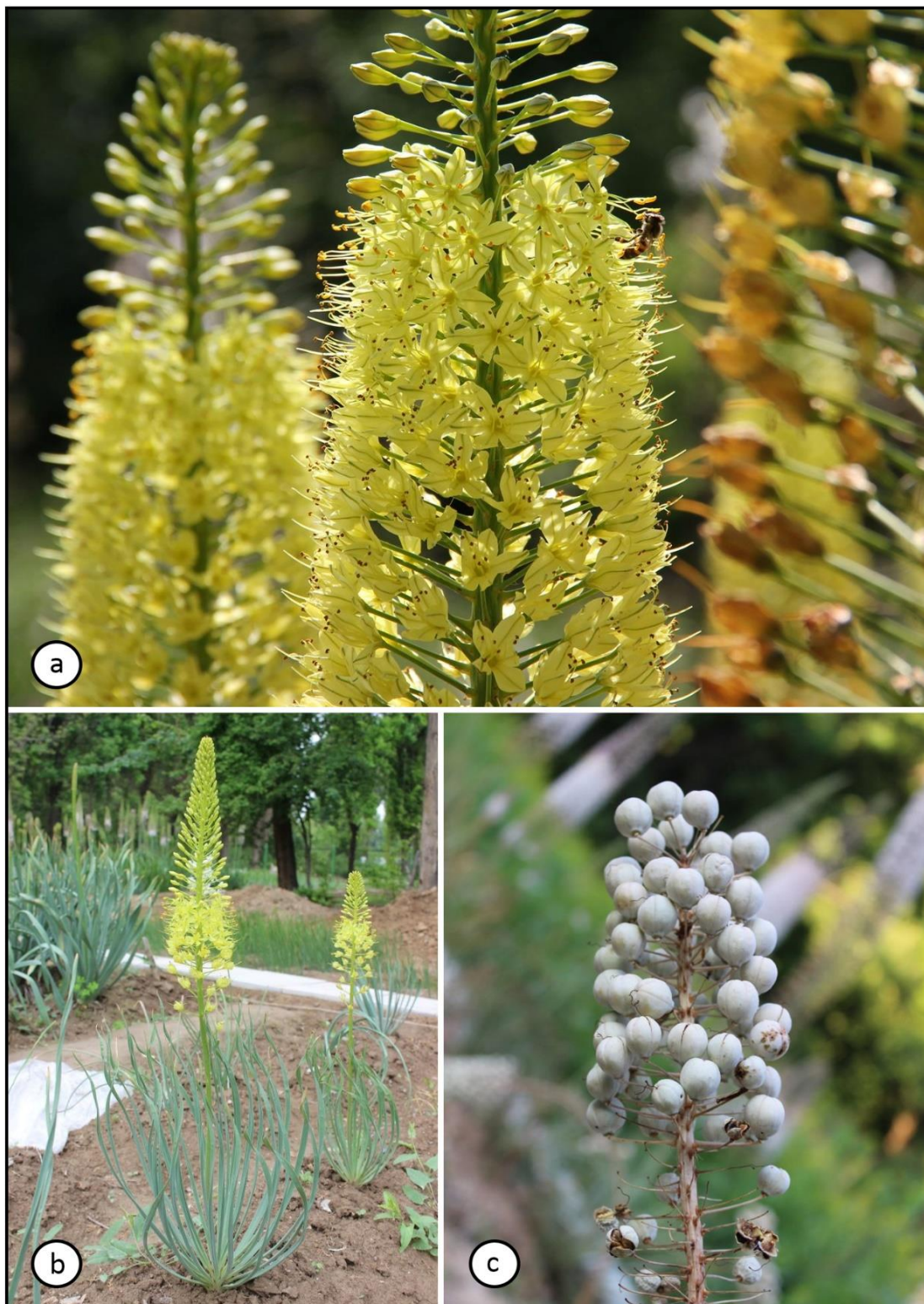


Fig. 14. *Eremurus stenophyllus* subsp. *ambigens*, a: inflorescence, b: general appearance, c: capsule. Photos by the authors.

(3) *Eremurus lachnostegius* Vved.

in Bot. Mater. Gerb. Inst. Bot. Akad. Nauk Uzbeksk. S.S.R. 14: 7 (1954). — *Henningia lachnostegia* (Vved.) A.P. Khokhr., Erem. Cult.: 83 (1965).

Type: Tajikistan. Western foothills of the Gardani-Ushti ridge, alt/1000 m., 03/20/1947, Varivtseva and Nepli 214 (holotype LE, isotype TASH).

Scape glabrous, rather thick, 30–60 cm. Roots slightly fusiform thickened, 5–7 mm thick. Leaves broadly linear, 20–25 cm long, outer 2.5–3 cm wide, glaucous, grooved, keeled, glabrous, along the margins and less often also along the keel, short and scabrous-ciliate. Raceme at the beginning of flowering loose, 10–20 cm long. Bracts black, triangular, long drawn, shaggy along the margins and especially along the back, slightly shorter than the pedicels. Pedicels bent outward at an angle of 45°, 1.5–2.2 cm long, articulated at the apex. Perianth stellate. Tepals single-nerve, light yellow, gradually narrowed towards the base, almost

marigold, outer obverse-lanceolate, almost boat-shaped, 1.8 cm long, 0.5 cm wide, Inner obverse-lanceolate-oblong, 1.9 cm long, 0.7 cm wide. Stamens unequal, from 10 to 13 mm long. Style exceeds the stamens. Ovary slightly wrinkled due to the transverse veins. Capsule unknown. Fig. 15.

Flowering: March–April.

Fruiting: April–May.

Ecology: on variegated soil, among pistachios; altitude 950–1000 m (Fig. 4).

General distribution: Central Asia (Pamir–Alay): Tajikistan, Uzbekistan.

Distribution in Uzbekistan: suppl. file 13.

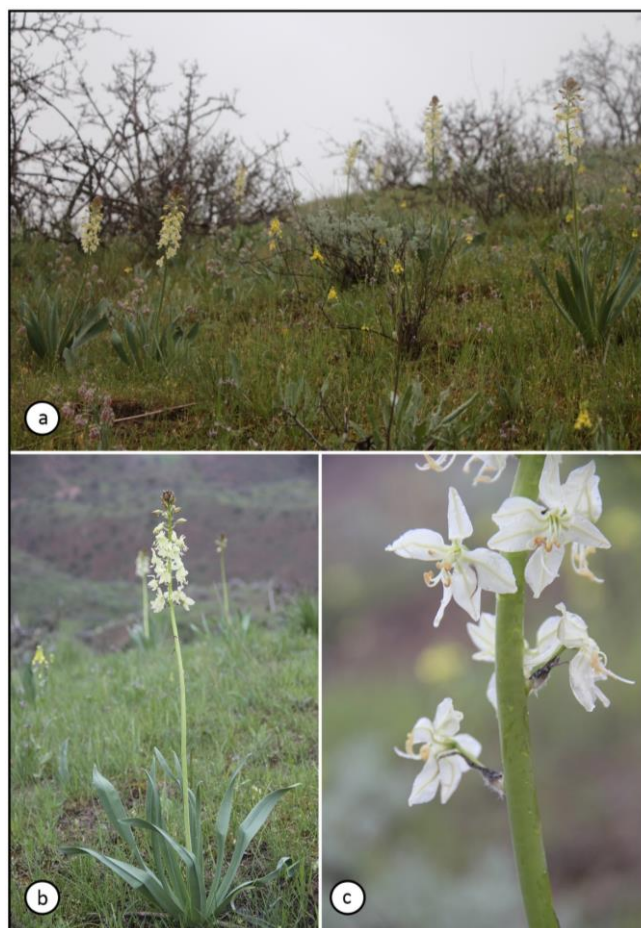


Fig. 15. *Eremurus lachnostegius*, a: habitat, b: general appearance, c: inflorescence. Photos by the authors.

(4) *Eremurus chloranthus* Popov

in Popov & Androsov. Rast. Zop. Gur. i Zaam. Lesn. Dachi 25 (1937); in Fl. Uzbekist., ed. Schreder, i. 406 (1941); in Bot. Mater. Gerb. Bot. Inst. Komarova Akad. Nauk S.S.S.R. 19: 631 (1959). — *Henningia chlorantha* (Popov) A.P. Khokhr., Erem. Cult.: 79 (1965). Type: Uzbekistan, Jizzakh, in the river gorge Guralash, 26.07.1926, Popov, Androsov (holotype TASH).

Scape 60–70 cm tall, glabrous. Roots slightly fusiform-thickened, 5–6 mm thick. Leaves broadly linear, outer about 15 mm wide, grooved, keeled, glabrous. Raceme dense, many-flowered, almost cylindrical, 20–25 cm long. Bracts narrow triangular-lanceolate, drawn, shaggy-ciliated. Pedicels slightly flexuous, the lower ones are slightly shorter than the perianth. Tepals with 1 vein, greenish, 14–15 mm long, external lanceolate, slightly narrower than internal oblong. Stamens 1.5 times shorter

than the perianth. Capsule and seeds unknown. Fig. 16.

Flowering: July.

Fruiting: unknown.

Ecology: On variegated rocky slopes.

General distribution: Central Asia (Pamir-Alay: Turkestan Range: Guralash. Found once by Androsov and Popov in the gorge of the river Guralash in flower 20 VII 1926): Uzbekistan. Endemic.

Distribution in Uzbekistan: suppl. file 14.



Fig. 16. *Eremurus chloranthus*, drawing from Tojibaev (2009).

(5) *Eremurus alberti* Regel

in Trudy Imp. S.-Peterburgsk. Bot. Sada 8: 668 (1884). — *Henningia alberti* (Regel) A.P. Khokhr., Erem. Cult.: 81 (1965).

Type: In eastern Bukhara to the south of the city of Kulab to the mountain Chodscha Mumyn, alt. 3000 m. April, A. Regel (Holotype LE).

Scape 90–100 cm. Root crowded, thick. Neck is surrounded by thick, fibrous remains of the old leaf and webbed ow. Dry scape ribbed, smooth. Leaves narrowly linear lanceolate, flat, up to 1.5 cm wide. Raceme lax, many flowered. Bracts white membranous, lanceolate gradually tapering. Pedicels thin at anthesis, fairly long (approx. 30–35 mm long), spaced, thickening at the end, horizontally extended. Perianth subrotate, segments pale red, narrowly oblong lanceolate, bend backwards until fruiting period. Stamens shorter than perianth. Capsule ovoid

globose, approximately 23 mm long and 20 mm wide, tapering upwards, smooth, with thick walls. Seed gray, wide-winged, large (with a wing of about 1 cm long.). Fig. 17.

Flowering: April.

Fruiting: May.

Ecology: On the loess foothills, gypsum hills and rocky slopes of the mountains (Fig. 17).

General distribution: Afghanistan, Central Asia (Pamir-Alay): Kyrgyzstan, Tajikistan, Uzbekistan.

Distribution in Uzbekistan: suppl. file 15.



Fig. 17. *Eremurus alberti*, a: habitat, b: general appearance, c: capsule. Photos by the authors.

(6) *Eremurus lactiflorus* O. Fedtsch.

in Bull. Herb. Boissier, sér. 2, 4: 773 (1904). — *Henningia lactiflora* (O. Fedtsch.) A.P. Khokhr., Erem. Cult.: 95 (1965).

Type: Uzbekistan. The western Tian-Shan, near Tschimgan, 1897 (holotype LE).

Scape 30–70(100) cm., glabrous, slightly reddish, seated at the top with bracts. Roots crowded, fleshy, thin, strongly fusiform-thickened, 4–6 mm thick. Neck is surrounded by membranous sheaths and loose fibrous remains of old leaves. Leaves bluish-green, linear, up to 4 cm wide; with fruits, the leaves are reddish at the base, grooved, keeled, smooth, shiny. Raceme lax, few-flowered (becomes multi-flowered in culture and contains up to 100 flowers), cylindrical, 15–30 (50) cm long. Bracts lanceolate from the base, linear, brownish, with dark median vein, glabrous. the Pedicels horizontally aberrant, the lower ones 1.5–2 times longer than the perianth. Tepals with 1 vein, milky white, at the very base with a yellow spot,

15–20 mm long. In the middle with one reddish vein, obverse-oblong, outer slightly narrower than the inner. Stamens slightly shorter than perianth, white, yellow at base, three of them longer; Style white. Ovary glabrous, smooth, yellow. Capsule very large (larger than all other species), triangular-globose, approx. 3.5 cm in diameter, strongly swollen, smooth, mature reddish. Seeds gray, wide-winged. Fig. 18.

Flowering: April-May.

Fruiting: June-July.

Ecology: on stony and clayey-gypsums slopes; altitude 1100–1200 m. (Fig. 19).

General distribution: Central Asia (Tien Shan): Kazakhstan; Kyrgyzstan; Uzbekistan.

Distribution in Uzbekistan: suppl. file 16.

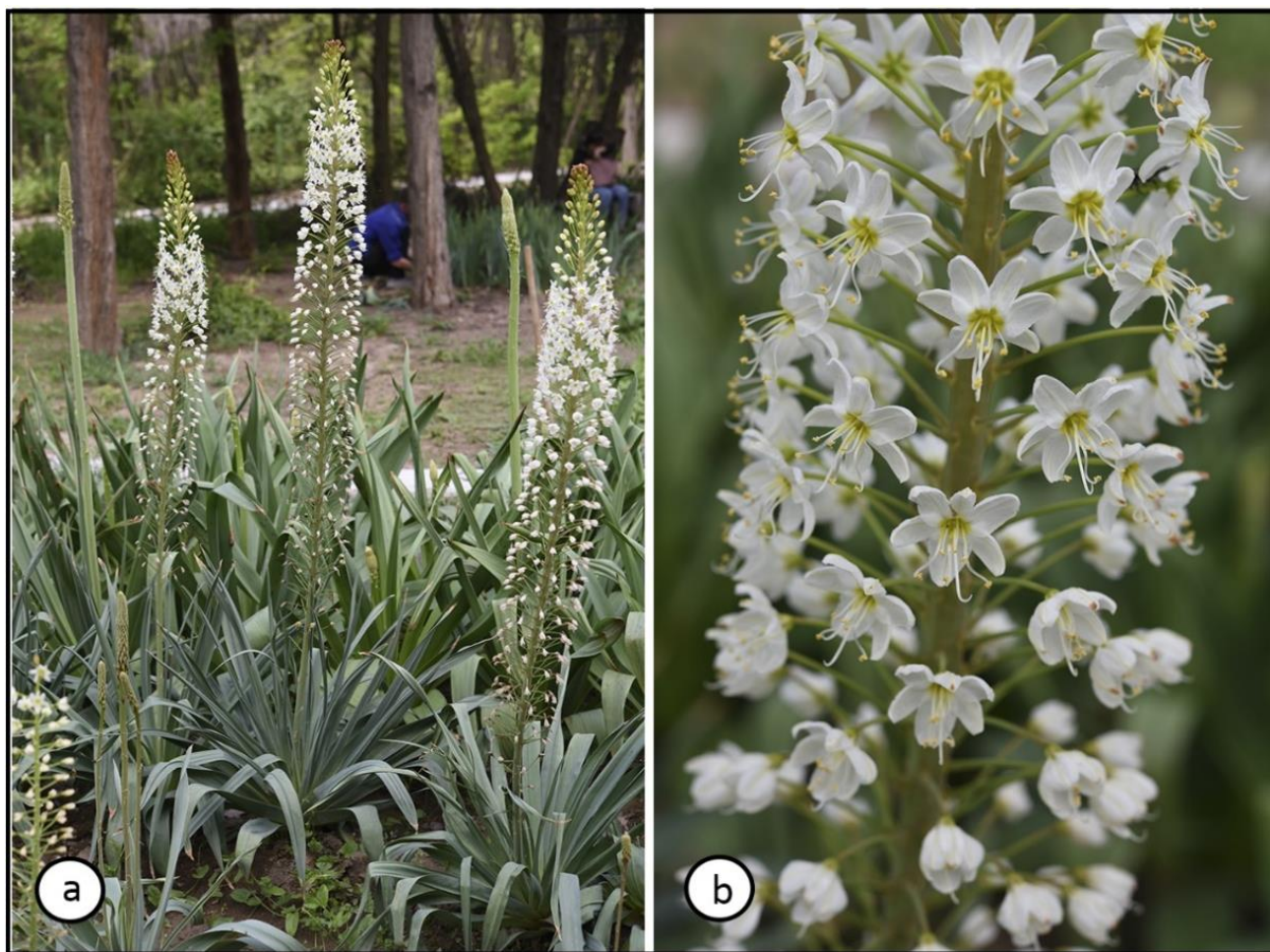


Fig. 18. *Eremurus lactiflorus*, a: habitat, b: general appearance, c: capsule. Photos by the authors.

(7) *Eremurus hilariae* Popov & Vved.

in Key Pl. Envir. Tashkent: 58 (1924). — *Henningia hilariae* (Popov & Vved.) A.P.Khokhr., Erem. Cult.: 96 (1965).

Type: Kazakhstan, Syr- arja, Tashkent, On the slopes of the elevated mound of Kyngrak, it was said to be the place of Kaplanbek. 28.04.1923, col. Rajkova. (holotype TASH).

Scape 30–90 cm. Stem glabrous, slightly pubescent at base, cylindrical, seated at the top with bracts. Roots fleshy, thin, strongly fusiform thickened. Neck surrounded by membranous sheaths and loose fibrous remnants of old leaves. Leaves gray or grayish, broadly linear, grooved, keeled, up to 25 mm wide. and up to 40 cm long, ciliate along the margin and along the veins scabrous. Raceme lax by the end of flowering or dense, few-flowered or multi-flowered, short, narrow, cylindrical, 10–25 cm long. Bracts narrowly triangular-lanceolate from the base, linear, long ciliated at the margins, with a dark longitudinal vein. Pedicels almost horizontally aberrant, lower ones slightly or 1.5 times as long as perianth; obliquely upward, later deflected almost horizontally, uniformly thickened throughout, 1.5 cm long. Perianth up to 35 mm in diameter. Tepals 1.5–1.7 cm long, with 1 vein,

white, at the very base with a yellow spot, outers lanceolate, 1.5 times narrower than inners, oblong, slightly curving inward after flowering. Stamens unequal, the longest equal to the perianth, of which 3 are shorter than the others; barely visible from the corolla. Ovary glabrous, smooth. Capsule very large (and almost the same size as the previous species), approx. 2–3 cm or more in diameter, smooth. Seeds large, wide-winged. Fig. 19.

Flowering: April.

Fruiting: May.

Ecology: on stony and clayey-gypsums slopes; altitude 1100–1200 m. (Fig. 19).

General distribution: Central Asia (Tien Shan): Kazakhstan; Kyrgyzstan; Tajikistan; Uzbekistan.

Distribution in Uzbekistan: suppl. file 17.

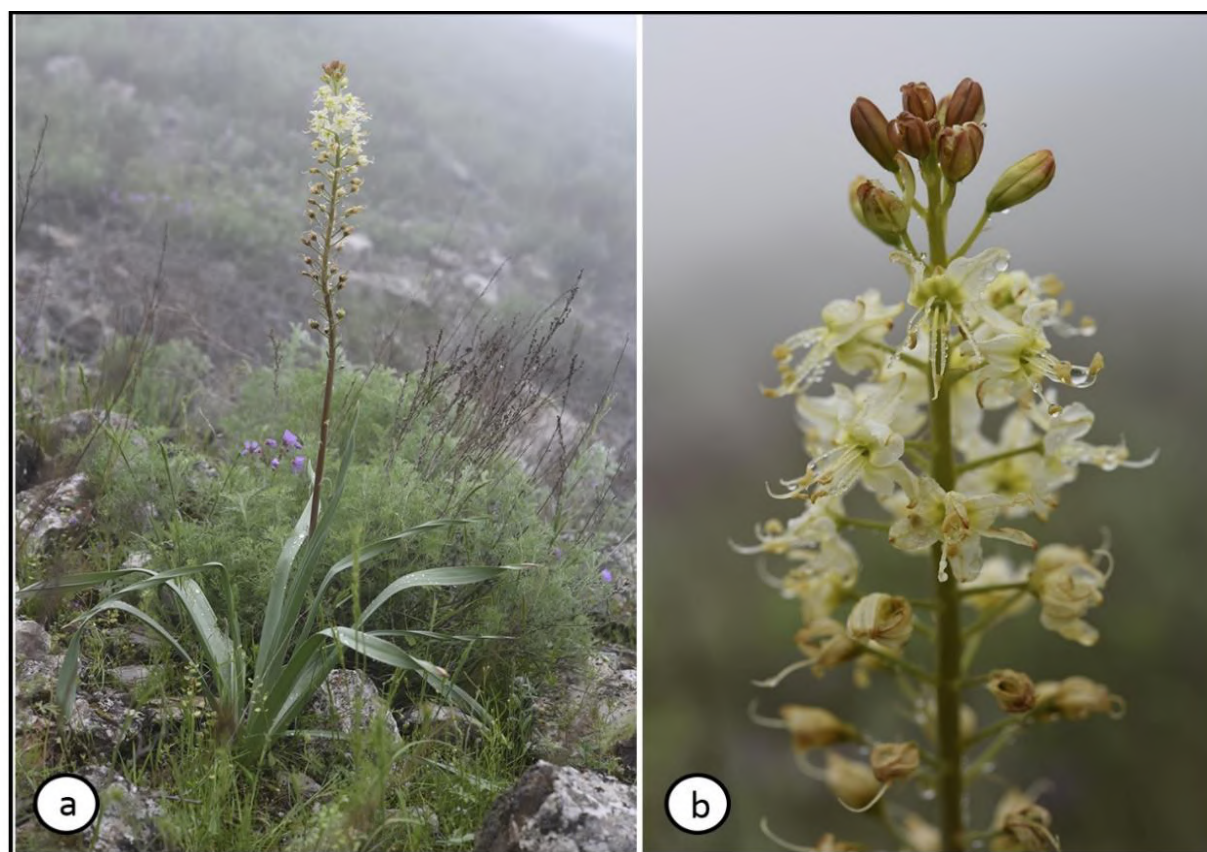


Fig. 19. *Eremurus hilariae*, a: general appearance, b: inflorescence. Photos by Authors.

(8) *Eremurus luteus* Baker

in J. Bot. 17: 18 (1879). — *Henningia lutea* (Baker) A.P. Khokhr., Erem. Cult.: 82 (1965).

Type: Persia, near Sser-tschah, 14.03.1859, Bunge (holotype K).

= *Eremurus capusii* Franch. in Ann. Sci. Nat., Bot., ser. 6, 18: 260 (1884). — *Henningia capusii* (Franch.) A.P. Khokhr., Erem. Cult.: 82 (1965).

Type: Uzbekistan. Salt clay desert, between Kilif and Kara-Kamar (Boukharie), alt. approx. 300 m, 28.03.1881, Capus 1282 (P).

Scape 20–60 cm., glabrous, Roots fusiform thickened, 6–7 mm thick. Stem thick, cylindrical, smooth. Roots spindle-thickened, 6–7 mm thick. Neck dense fibers-putrid. Neck thick-fibrous. Leaves numerous, straight or somewhat drooping, narrowly linear, grooved from above, ciliate along the margins, shorter than the spike, outer 6–7 mm wide, semicircular-triangular, glaucous, glabrous. Raceme lax, relatively few-flowered, cylindrical-conical, 20–30 cm long. Bracts at base broadly triangular, sharpened to the top, long hairy-ciliated, shorter or equal to pedicels, aberrant from the inflorescence axis. Pedicels almost horizontally aberrant, the lower ones are 1.5 times longer than

the perianth. Tepals with 1 vein, very pale yellow, at the base with yellow diffuse spot, 15–19 mm long., oblong, outer almost 1.5 times narrower than inner. Stamens very unequal, slightly 2 times shorter than the perianth. Capsule upward directed, smooth, oblong clavate. Seeds wrinkled, broadly winged. Fig. 20.

Flowering: April.

Fruiting: May.

Ecology: On variegated rocky slopes of mountains.

General distribution: Afghanistan, Iran, Central Asia: Tajikistan, Turkmenistan, Uzbekistan.

Distribution in Uzbekistan: suppl. file 18.



Fig. 20. *Eremurus luteus*, a: general appearance, b: inflorescence. Photos by the authors.

(9) *Eremurus baissunensis* O. Fedtsch.

in Bot. Mater. Gerb. Glavn. Bot. Sada R.S.F.S.R. 2: 9 (1921). — *Henningia baissunensis* (O. Fedtsch.) A.P. Khokhr., Erem. Cult.: 83 (1965).

Type: Uzbekistan. Between Akrobat and Derbent railway stations (holotype unknown).

Scape 60–80 cm. Roots fusiform, 4–6 mm thick. Leaves narrowly linear, 4–6 mm wide. Raceme loose, multi-flowered, 25–45 cm long. Bracts large, triangular-lanceolate. Pedicels large, 1.5 times as long as the perianth. Tepals with 1 vein, white. Stamens unequal, shorter than the perianth. Capsule elongated, smooth, 6–7 mm wide, 15–20 mm long. Seeds narrowly winged. Fig. 21.

Flowering: April-May.

Fruiting: May-June.

Ecology: Variegated rocky and gypsum soil (Fig. 21).

General distribution: Central Asia: Uzbekistan. Endemic.

Distribution in Uzbekistan: suppl. file 19.

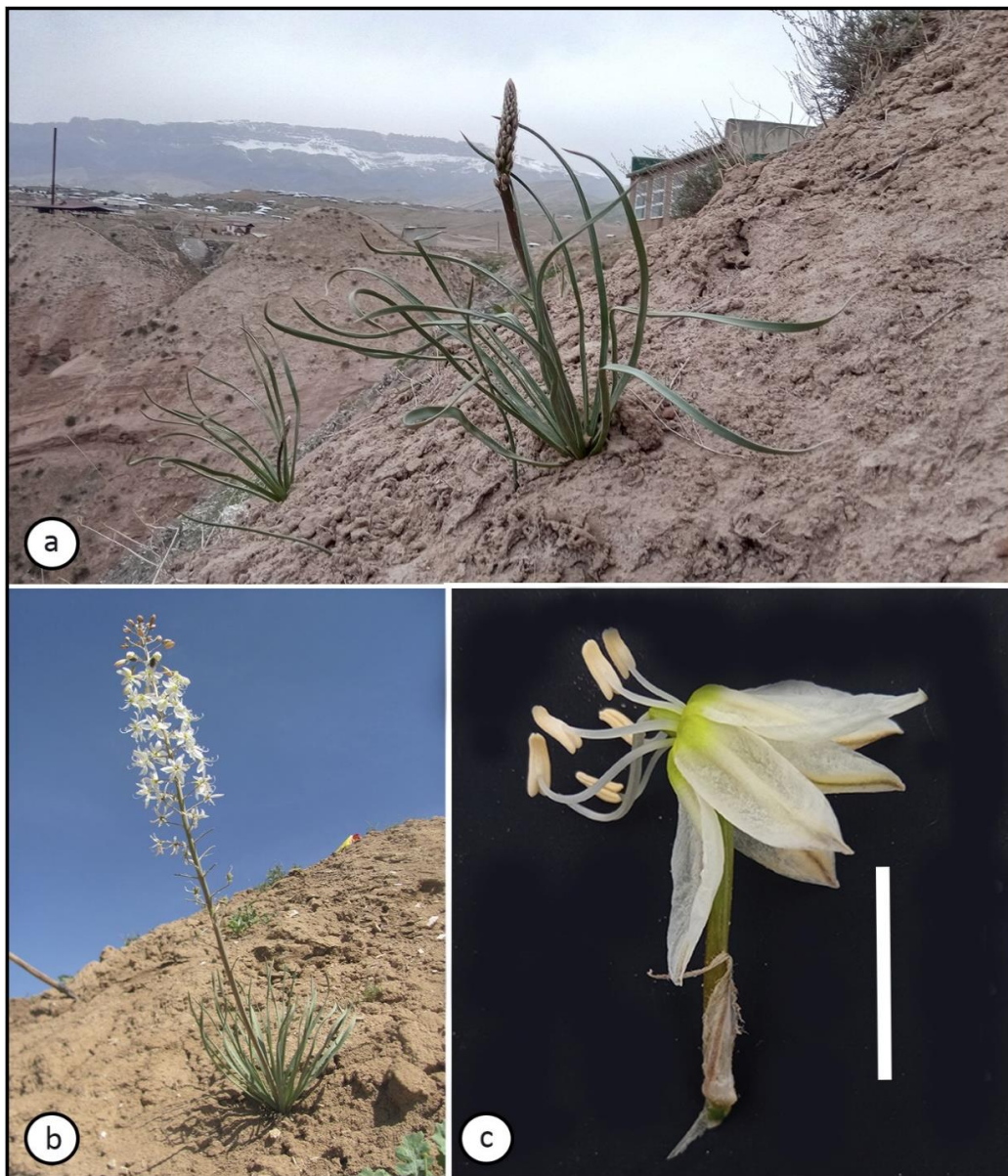


Fig. 21. *Eremurus baissunensis*, a: general appearance, b: inflorescence, c: flower. Photos by the authors.

(10) *Eremurus pubescens* Vved.

in Bot. Mater. Gerb. Bot. Inst. Komarova Akad. Nauk S.S.S.R. 9: 234 (1946). — *Henningia pubescens* (Vved.) A.P. Khokhr., Erem. C ult.: 86 (1965).

Type: Tajikistan. In the valley of the river Mogian-darya to the south-western cement slopes in the place of Navdanak. 28.07.1933, Butkov 167 (holotype TASH?).

Scape 80–100 cm tall, densely pubescent to the very top, rather thick. Roots fusiform, 5–7 mm thick. Leaves linear, outer about 2 cm wide, grooved, keeled, densely pubescent. Raceme loose, multi-flowered, 40–55 cm long. Bracts narrowly triangular, long drawn, shaggy. Pedicels horizontally spreading, densely pubescent, lower ones 2–2.5 times longer than perianth. Tepals with 1 purplish, pubescent vein, apparently white, up to 1.4 cm long, oblong, slightly narrower than the outer ones. Stamens slightly shorter than the tepals. Capsule

spherical, thin-skinned, about 1.5 cm wide. Seeds large, about 1 cm long, wide-winged. Fig. 22.

Flowering: May.

Fruiting: June.

Ecology: In the zone of shiblyak and thermophilic juniper forests, on gravelly slopes of mountains (Fig. 22).

General distribution: Central Asia (Pamir-Alay): Tajikistan, Uzbekistan.

Distribution in Uzbekistan: suppl. file 20.

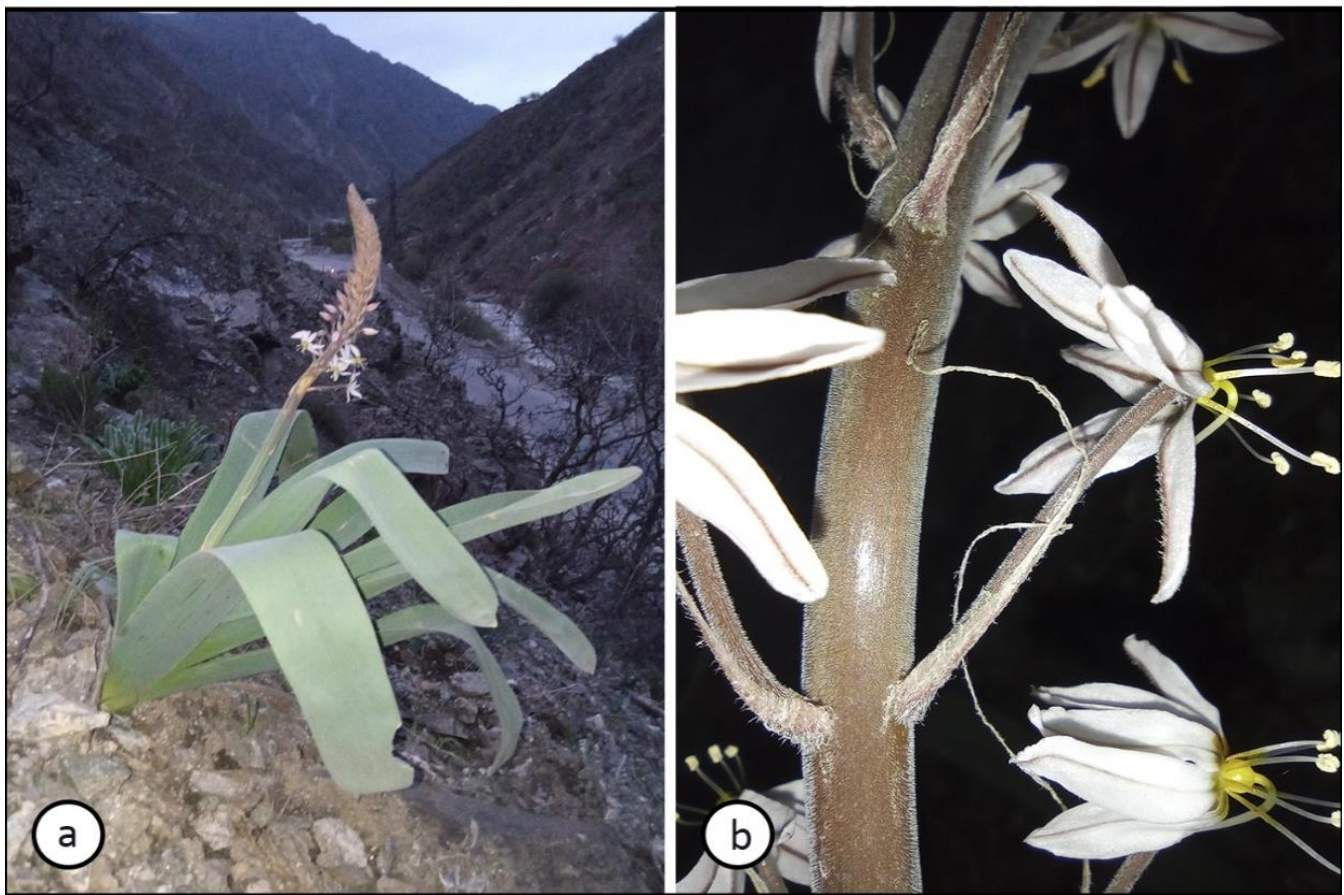


Fig. 22. *Eremurus pubescens*, a: general appearance, b: inflorescence. Photos by the authors.

(11) *Eremurus kaufmannii* Regel

in Acta Horti Petrop. 2: 430 (1873); in Gartenflora 22: 260 (1873). — *Henningia Kaufmanniana* Rgl. Katal. Turkest, Otd. Politekhn. Vyst. v Moskve (1872).

Type: Uzbekistan, in the valley Sarawschansk, (holotype LE).

= *Eremurus griffithii* Baker in J. Linn. Soc., Bot. 15: 283 (1876).

Type: Afghanistan, Griffith 5803 (holotype unknown).

= *Eremurus schiwanus* O. Fedtsch., in Zap. Imp. Akad. Nauk Fiz. -Mat. Otd. 23(8): 153 (1909). — *Henningia schiwana* (O. Fedtsch.) A.P. Khokhr., Erem. Cult.: 79 (1965).

Type: Afghanistan. Mountains at the Shiva pass, between the river Pändzh and Lake Shiva, 11-12000', 8-9.10.1882, A. Regel. The label says Schugnan; more correct would be: Badakhshan (holotype unknown).

Scape (30)70–100(150) cm tall, the lower part pubescent, seated bracts in the upper part. Root fleshy, fusiform thickened, 7–9 mm thick. Neck densely surrounded by black, fibrous remains of old leaves. Leaves broadly linear, outer (0.5)1.5–2.5(3.5) cm wide, 25–30 cm long, grooved, keeled, glaucous, densely short-pubescent. Raceme very dense, multi-flowered, cylindrical, 10–40 cm long. Bracts triangular, drawn-out, hairy or densely hairy-ciliate. Pedicel aberrant, the lower ones are slightly shorter than the perianth, with fruits almost pressed to the axis of the inflorescence, emerging, straight, rather thin, at the apex with a joint. Perianth campanulate, Tepals 1.5–2.2 cm long, with 1 vein, white, at the very base with a yellow spot,

narrowed to the base, outer lanceolate, 1.5 times narrower than the inner, oblong. Stamens widened at the base, almost equal to the perianth. Style white. Ovary globular, yellowish. Capsule globose, smooth, 1–1.2(1.4) cm wide. thin walled. Seeds brown-gray, wide-winged. Fig. 23.

Flowering: June-July.

Fruiting: July-August.

Ecology: In mountain meadows, in steppes and cryophilic juniper forests; on gravelly slopes; altitude 1600–2800(3000) m (Fig. 23).

General distribution: Afghanistan, Central Asia (Pamir-Alay): Kyrgyzstan; Tajikistan; Uzbekistan.

Distribution in Uzbekistan: suppl. file 21.

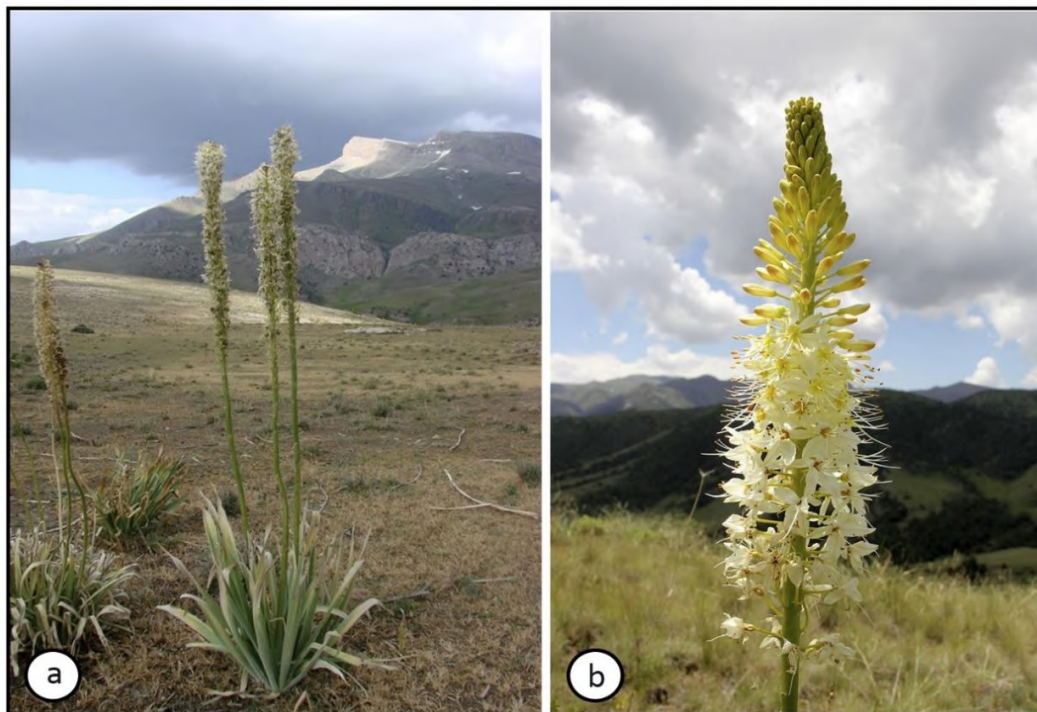


Fig. 23. *Eremurus kaufmannii*, a: habitat and general appearance, b: inflorescence. Photos by Natalia Beshko, www.plantarium.ru.

(12) *Eremurus parviflorus* Regel

in Trudy Imp. S.-Peterburgsk. Bot. Sada 9: 609 (1886). — *Henningia parviflora* (Regel) A.P. Khokhr., Erem. Cult.: 87 (1965).

Type: Tajikistan. In the east of Bukhara in the district of Taschbulak, in the Hissar mountains and in the passage of the mountains of Gasi - Mailik above Choschbulak, alt. 6000 ft. ?08.1883, A. Regel (holotype unknown).

Scape 60–120 cm long, Narrow-conical raceme, leaves 4–8 mm wide, stem and leaves in the lower part are rarely short-haired, bracts 7–11 mm long. Pedicels 25–50 mm long, Tepals 9–11 mm long, White, with a black middle vein, the stamens are slightly shorter than perianth, the capsule is ovoid-spherical. Fig. 24.

Flowering: April.

Fruiting: May.

Ecology: On variegated rocks in the foothills.

General distribution: Central Asia (Pamir-Alay): Tajikistan, Uzbekistan.

Distribution in Uzbekistan: suppl. file 22.

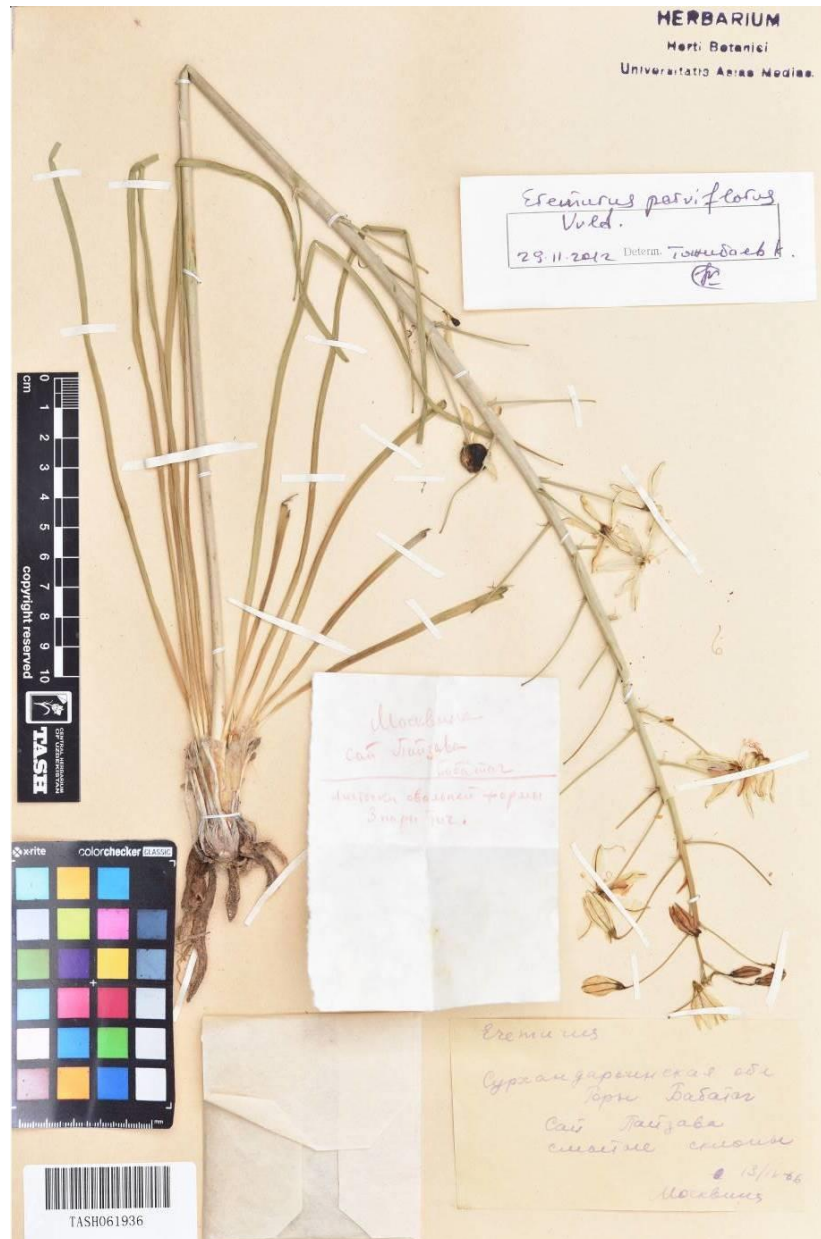


Fig. 24. *Eremurus parviflorus*.

(13) *Eremurus anisopterus* (Kar. & Kir.) Regel

in Gartenflora 22: 260 (1873). — *Henningia anisoptera* Kar. & Kir. in Bull. Soc. Imp. Naturalistes Moscou 15: 517 (1842).

Type: Kazakhstan. Between Sassyk-pastau spring and Arganaty (holotype LE).

Scape 25–70 cm tall, fluffy at the base, naked upwards, glabrous, stocky, 4–17 mm in diameter, smooth at the top. Roots fusiform, fleshy, 25 cm or more in length, not strongly fusiform-thickened, 4–6 mm thick. Neck is seated with membranous sheaths and fibers; hairy and webbed. Leaves narrow linear, triangular, up to 65 cm long, 6–15 mm wide, smooth on the surface, rough along the margin, membranous-vaginal to the base, sheaths are dotted with short appressed hairs. Raceme sparse, sprawling. Bracts membranous, lanceolate, wider at the base; broadly triangular-lanceolate, elongated at the apex, with a dark (dry greenish-brown) keel abaxially, long hairy-ciliated along the margin. Pedicels bent outward during flowering, with fruits usually stretched out with articulation at the top; slightly (with fruits almost horizontally) deviated, lower ones slightly 2 times longer than the perianth; ascending during flowering, sometimes prostrate in fruits, with articulation at the top (during

flowering, articulation is imperceptible), 2–4 cm in length. Perianth spherical-campanulate. Tepals convergent after flowering, white or pale pink, with a dark spot at the base; remaining, 16 mm in length, 8–10 mm in width, with a pronounced dark keel, the perianth vein is naked outside, fluffy inside. Stamens 1.5 times shorter than the perianth, 8–10 mm long. Style curved 8 mm length subsequently outstanding. Capsule spherical, up to 20 mm in diameter, smooth, with rigid valves. Seeds strongly wrinkled, wide-winged, 1 cm long with a wing, dirty yellowish, mottled on the surface and on the wings with dark spots and stripes. Fig. 25.

Flowering: April-May.

Fruiting: May.

Ecology: In sandy deserts, on moving and fixed sands (Fig. 25).

General distribution: China: Xinjiang, Central Asia: Kazakhstan, Uzbekistan.

Distribution in Uzbekistan: suppl. file 23.

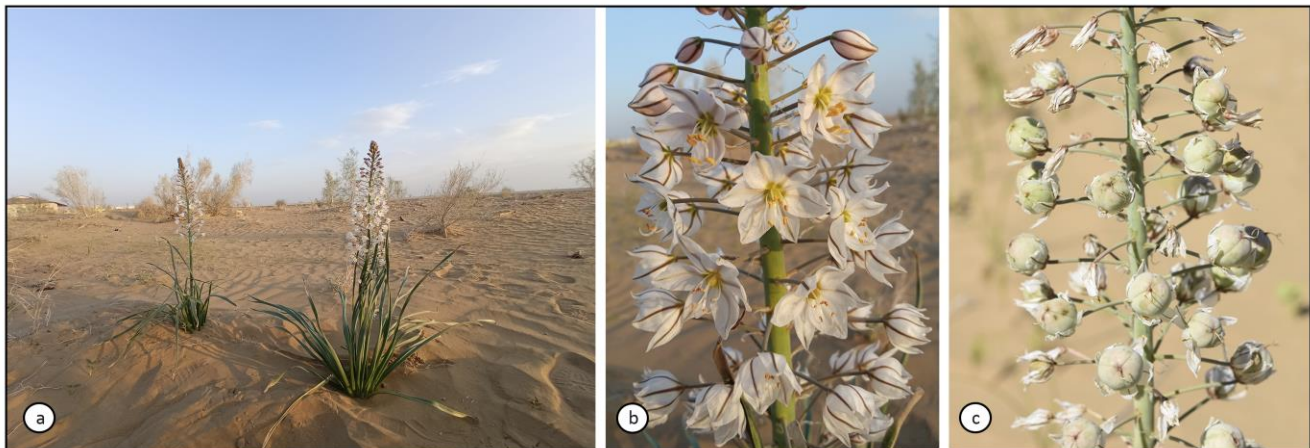


Fig. 25. *Eremurus anisopterus*, a: habitat and general appearance, b: inflorescence, c: capsule. Photos by the authors.

(14) *Eremurus ammophilus* Vved.

in Opred. Rast. Sred. Azii 2: 311 (1971).

Type: Turkmenistan. In desert near railway station Akhcha-Kuyma, 14.04.1912, Androsov (holotype LE).

Scape 40–70 cm. Roots fusiform, 4–6 cm thick.

Leaves narrowly linear-ciliate, outer leaves are 0.5–0.7 cm wide. Raceme 10–30 cm in height.

Bracts triangular, pubescent. Capsule spherical, about 1.5 cm wide. Fig. 26.

Flowering: April.

Fruiting: May.

Ecology: On moving and fixed sands (Fig. 26).

General distribution: Central Asia: Turkmenistan, Uzbekistan.

Distribution in Uzbekistan: suppl. file 24.

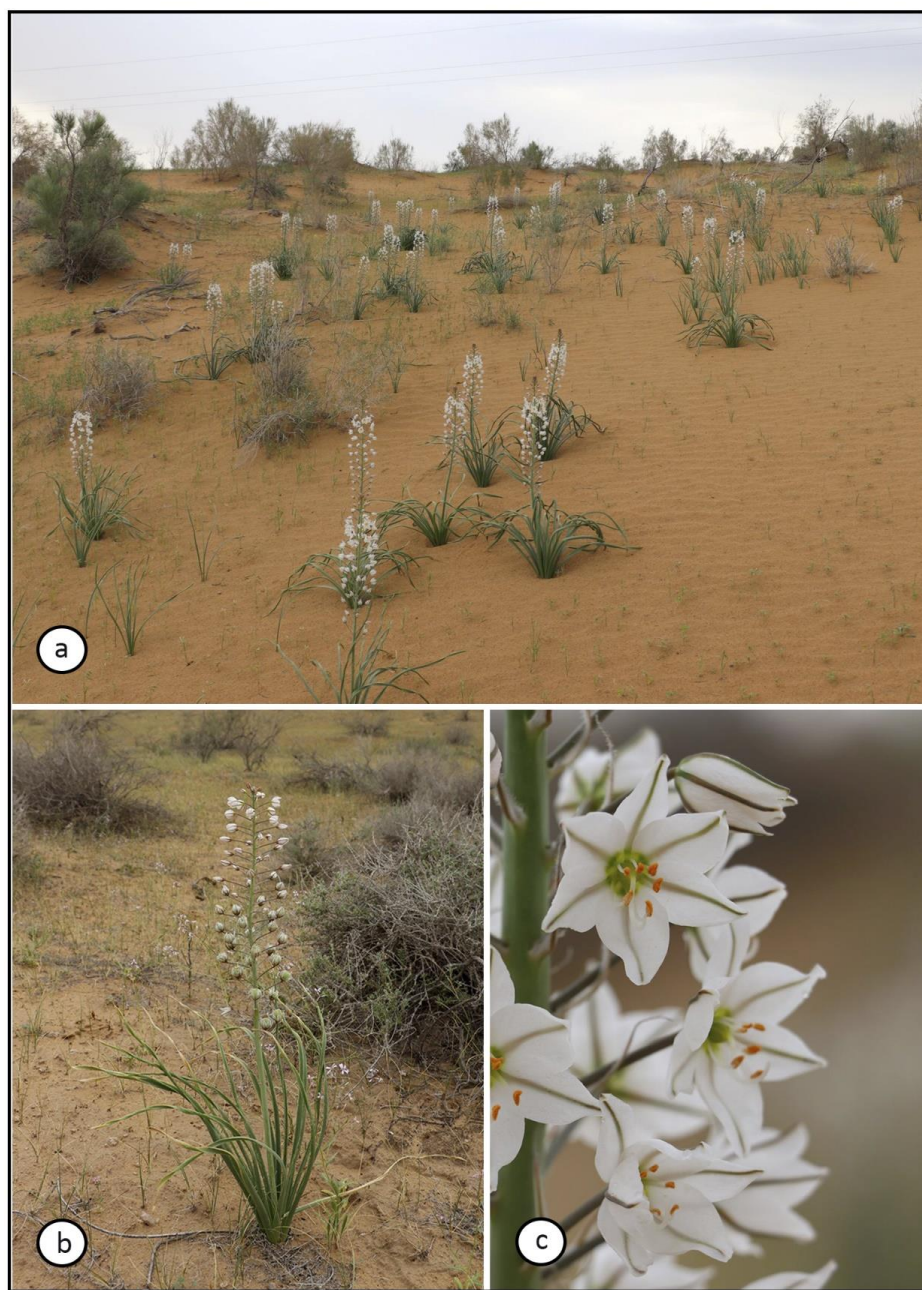


Fig. 26. *Eremurus ammophilus*, a: habitat, b: general appearance, c: inflorescence. Photos by Natalia Beshko, www.plantarium.ru.

(15) *Eremurus suworowii* Regel

in Trudy Imp. S.-Peterburgsk. Bot. Sada 8: 672 (1883). — *Henningia suworowii* (Regel) A.P. Khokhr., Erem. Cult.: 87 (1965).

Type: Tajikistan, eastern Bukhara, Baldschuan to the river Kysil-su, alt., 3000 m, col. A. Regel (holotype LE).

Scape 50–70(100) cm tall, usually rough-fluffy below. Roots spindle-shaped thickened, 5–10 mm thick, few. Leaves narrowly linear, outer 3–5(7) mm wide, in cross-section triangular or keeled, grooved, glaucous, glabrous, roughly fluffy along the margin or over the entire surface. Raceme loose, usually relatively few-flowered, almost cylindrical, 15–30(50) cm long. Bracts narrow triangular, gradually narrowed from the base, sparsely shaggy-ciliate. Pedicels bent outward (deviated), the lower ones are often 1.5–2.5 times longer than the perianth, less often slightly shorter than it, with fruits horizontally deflected. Tepals with 1 vein, pale

yellow, with a yellow spot at the base, 1–1.5 cm long, external lanceolate, 1.5–2 times narrower than internal, broadly oblong. Stamens almost equal in length, slightly or almost 1.5 times shorter than the perianth, with greenish-yellowish filaments. Capsule spherical, smooth, 10–17 mm wide. Seeds oblique-winged. Fig. 27. Flowering: April–May.

Fruiting: May–June.

Ecology: On clayey slopes in the lower zone of the mountains; altitude 800–1900 m (Fig. 27).

General distribution: Afghanistan, Central Asia (Pamir-Alay): Tajikistan, Uzbekistan.

Distribution in Uzbekistan: suppl. file 25.

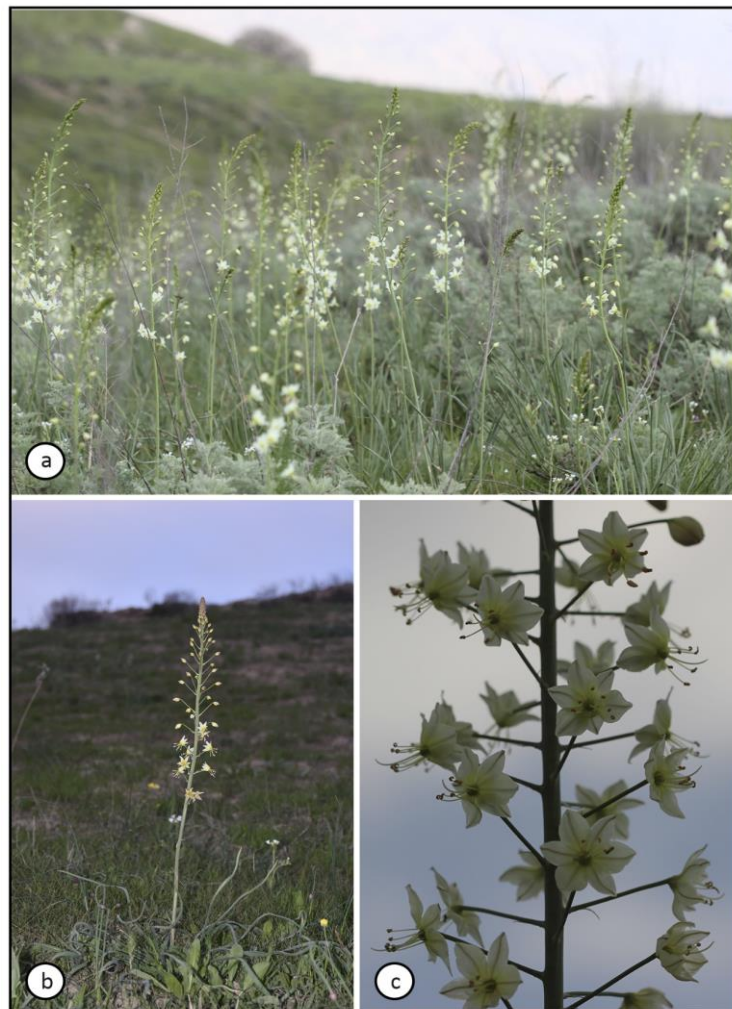


Fig. 27. *Eremurus suworowii*, a: habitat, b: general appearance, c: inflorescence. Photos by Sardor Pulatov.

(16) *Eremurus olgae* Regel

in Acta Horti Petrop. 2: 430 (1873); Gartenflora 22: 260 (1873).

Type: Uzbekistan, in the valley Sarawschan, alt. 2000–3000 m. O. Fedschenko; in the mountains near Tashkent, Krause; in Kokania, O. Fedschenko (Syntypes LE).

= *Eremurus angustifolius* Baker in J. Linn. Soc., Bot. 15: 282 (1876). — *Henningia angustifolia* J. Gay ex Baker in J. Linn. Soc., Bot. 15: 282 (1876).

Type: Afghanistan, Griffith 5799 (holotype K).

= *Eremurus aschersonii* Kuntze in Trudy Imp. S.-Peterburgsk. Bot. Sada 10: 243 (1887).

Type: Turkmenistan, in the mountains near Aschabad (holotype NY).

Scape 50–160 cm tall, thin, cylindrical, naked. Roots fusiform thickened, fleshy, 7–10 mm thick, up to 35 cm long. Neck surrounded by fibrous leftovers and membranous sheaths. Leaves narrowly linear, outer 0.2–1.5 cm wide, about 30 cm long, keeled, grooved, glaucous, smooth, glabrous, scabrous along the margin and keel, wilting by the time of flowering. Raceme long, but not particularly, dense, multi-flowered, conical, 30–50 cm long, in general outline almost cylindrical or noticeably narrowed towards the apex. Bracts glabrous, filiform-subulate, membranous at the base, shorter than pedicels. Pedicels horizontally deflected, lower ones up to 5 times longer than tepals; with articulation at the end, lower 25–45 (sometimes 60) mm, upper hand 22–25 mm long. Perianth

wide disclosed (almost wheel-shaped). Tepals with 1 vein, pale pink, at the very base with a yellow spot, 1.2–1.6 cm long, internal 8 mm wide, external lanceolate, narrower internal, broadly oblong. Stamens pale, of the same length as perianth. Style outstanding. Capsule spherical, smooth, leathery, naked, 0.8–1.2 cm wide. Seeds gray, narrowly winged, finely transversely wrinkled, 5–7 mm long. Fig. 28.

Flowering: May–July.

Fruiting: June–August.

Ecology: On loess slopes of foothills and mountains (Fig. 28).

General distribution: Afghanistan, Iran, Central Asia: Kyrgyzstan, Tajikistan, Turkmenistan, Uzbekistan.

Distribution in Uzbekistan: suppl. file 26.

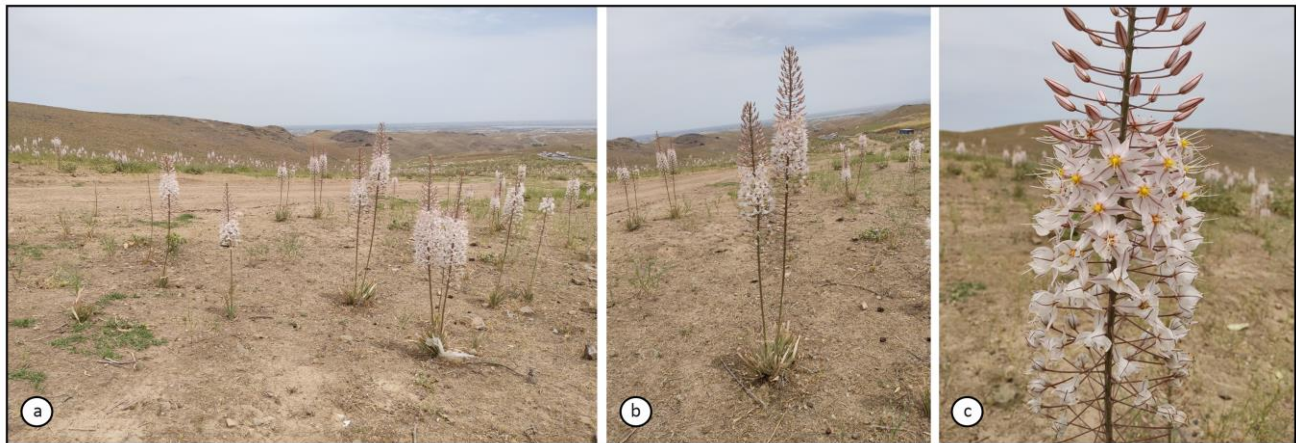


Fig. 28. *Eremurus olgae*, a: habitat, b: general appearance, c: inflorescence. Photos by the authors.

(17) *Eremurus korowinii* B. Fedtsch

in V.L. Komarov (ed.), Fl. URSS 4: 733 (1935). — *Henningia korowinii* (B. Fedtsch.) A.P. Khokhr., Erem. Cult.: 86 (1965).

Type: Uzbekistan, at the trajectory of Kendyraus 20.05.1880, A. Regel; in the Angren valley of Uzbekistan, 2200 m. over the sea, 19.06.1924, Korowin (holotype LE).

Scape 60–80 cm tall, at the bottom is fluffy, above naked, up to 8 mm in diameter. Roots slightly thickened, fusiform, 3–5 mm thick, numerous. Neck the root collar is densely surrounded by black, fibrous remnants of old leaves. Leaves narrowly linear, outer 7–20 mm wide, grooved, keeled, glaucous, densely short-haired, pointed, up to 30 cm long, do not reach the base of the inflorescence. Raceme loose, multi-flowered, cylindrical, 20–30 cm long, 6 cm wide. Bracts large, triangular, long drawn out, sparsely shaggy ciliated; linear-lanceolate, membranous, with 1 dark vein, sparsely hairy along the margin. Pedicels deviated, obliquely upward, the lower ones are 1.5–2 times longer than the perianth, slightly exceeding the flowers during flowering. Perianth wide campanulate.

Tepals 1.6–1.8 cm long, and about 5 mm wide, light pink, at the very base with a yellow spot, oblong, outer almost 1.5 times narrower than inner. Stamens of different lengths, the longest ones are slightly shorter than the tepals, the shortest ones are almost 1.5 times shorter than them. Style white, threadlike. Ovary spherical. Capsule spherical, smooth, 1–1.5 cm wide, with thin walls. Fig. 29.

Flowering: June.

Fruiting: June-July.

Ecology: On stony slopes in the middle zone of the mountains.

General distribution: Central Asia (Tien Shan): Kazakhstan, Tajikistan, Uzbekistan.

Distribution in Uzbekistan: suppl. file 27.

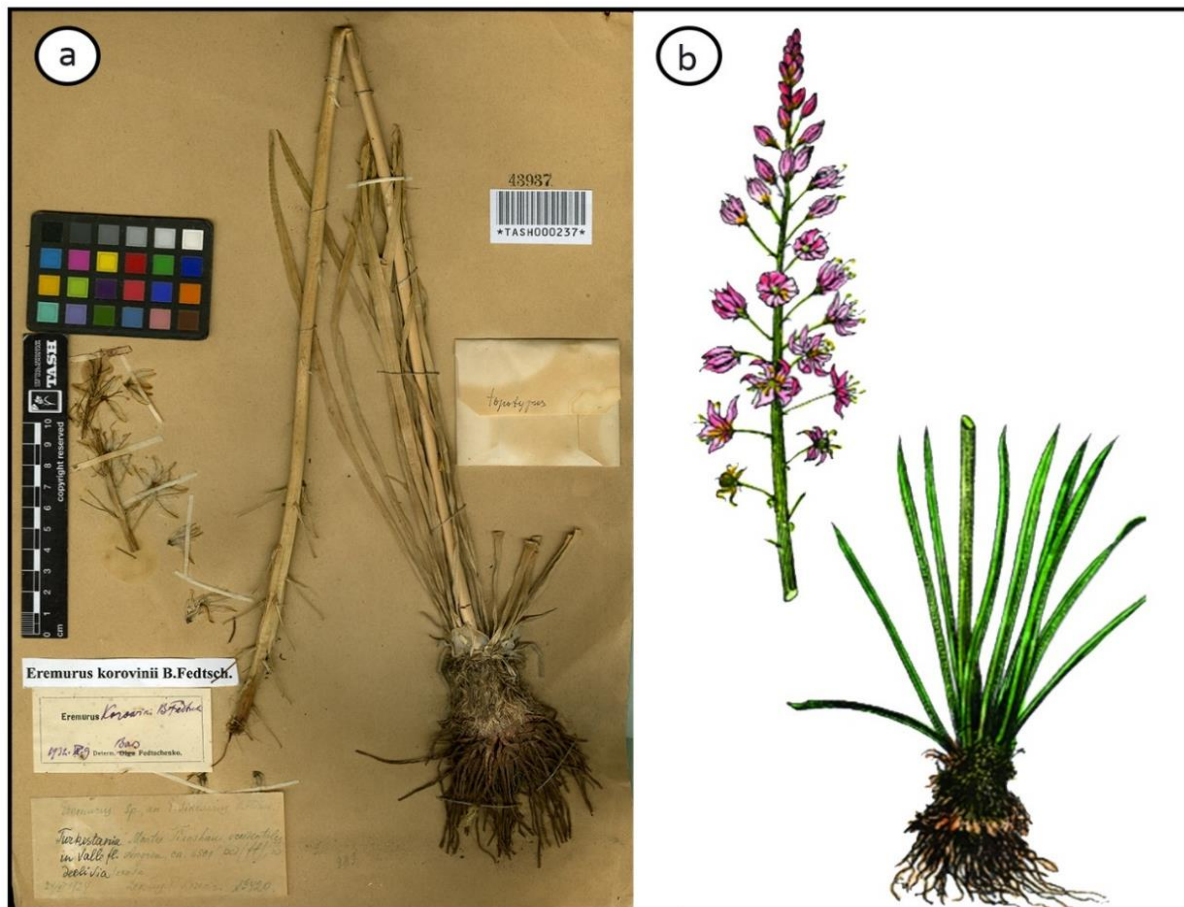


Fig. 29. *Eremurus korowinii*, a: topotype, b: general appearance. Drawing from Tojibaev (2009).

(18) *Eremurus roseolus* Vved.

in Bot. Mater. Gerb. Bot. Inst. Komarova Akad. Nauk S.S.S.R. 9: 235 (1946). — *Henningia roseola* (Vved.) A.P.Khokhr., Erem. Cult.: 90 (1965).

Type: Tajikistan, the western slopes of the Ak-tau ridge near the route of Kalegozy, alt. ca. 1600 m. 31.05.1939, J. S. Grigorjev and I. A. Linczevski, no. 20 (holotype LE).

= *Eremurus alboroseus* Wendelbo in Aarbok Univ. Bergen, Mat.-Naturvidensk. Ser. 5: 22 (1964). — *Henningia alborosea* (Wendelbo) A.P.Khokhr., Erem. Cult.: 88 (1965). Type information is not found.

= *Eremurus mirabilis* Rjabov in Novosti Sist. Vyssh. Rast. 1968: 35 (1968).

Type: Uzbekistan, at the trajectory of Kendyraus 20.05.1880, A. Regel; in the Angren valley of Uzbekistan, 2200 m. over the sea, 19.06.1924, Korowin (holotype LE).

Scape 70–100 cm high, densely pubescent below. Roots fusiform thickened, 4–7 mm thick. Leaves linear, outer leaves 0.8–1.5 cm wide, grooved, keeled, densely pubescent. Raceme loose, almost cylindrical, 25–50 cm long. Bracts narrowly triangular, long drawn, hairy ciliate. Pedicels almost horizontally deflected, twice as long as the perianth. Tepals with 1 dirty purple vein, pink, 18–20 mm long, outer lanceolate, 1.5 times narrower than inner ones, elliptical, narrowed into a short nail. Stamens unequal, the

longest ones are slightly longer or slightly shorter than the tepals, the shortest ones are 1.5 times shorter than tepals. Fig. 30.

Flowering: May–June.

Fruiting: May–July.

Ecology: in the lower zone of mountains, altitude 900–2000 m (Fig. 30).

General distribution: Afghanistan, Central Asia: (Pamir-Alay): Tajikistan, Uzbekistan.

Distribution in Uzbekistan: suppl. file 28.

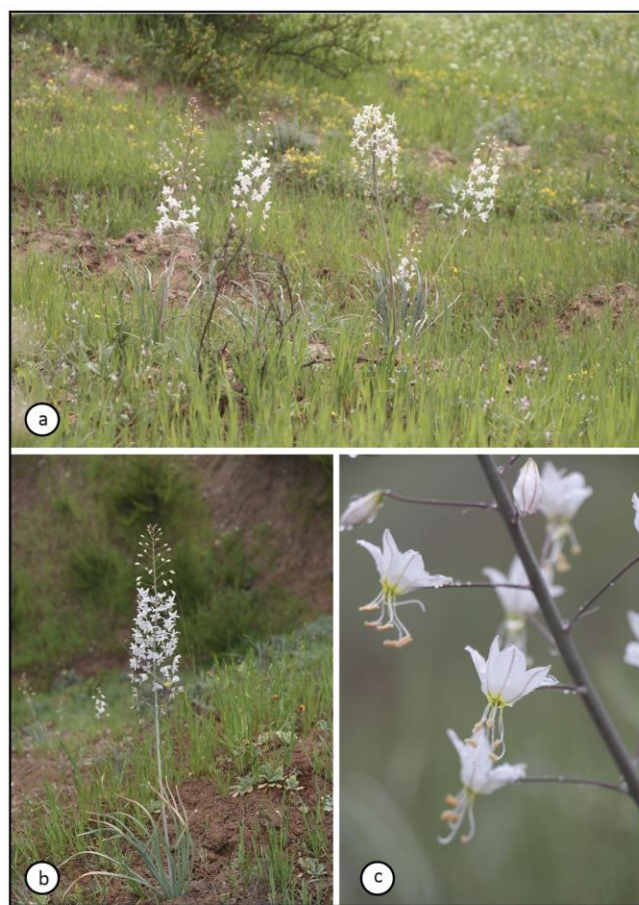


Fig. 30. *Eremurus roseolus*, a: habitat, b: general appearance, c: inflorescence. Photos by Sardor Pulatov.

(19) *Eremurus tianschanicus* Pazij & Vved. ex Pavlov

in Fl. Kazakhst. 2: 114 (1958).

Type: Kazakhstan. Karatau, Kujuk. 01.07.1922, A. I. Vvedensky 1695, (Holotype TASH).

= *Henningia altissima* A.P.Khokhr., Erem. Cult.: 90 (1965).

Type: Kyrgyzstan, Osh region, distr. Kokbel, near the village of Ak-bura. The narrowness of the river Akbura on the rocky slopes 22.6.1961, A. Khokhrjakov (holotype MHA).

Scape 50–160 cm tall, glabrous or usually scabrous-pubescent at the base. Roots fusiform thickened, 7–10 mm thick. Leaves narrowly linear, outer 5–15 mm wide, keeled, grooved, glaucous, glabrous, scabrous along the margin and keel. Raceme dense, multi-flowered, cylindrical, 30–60 cm long. Bracts gradually narrowed from the base, filiform, usually scattered curly-ciliate. Pedicels almost horizontally deflected, equal to or slightly longer than the wheel-shaped perianth. Tepals with 1 vein, pale pink, at the very base with a yellow spot, 10–12 mm long, the outer ones are

narrower than internal. Stamens slightly longer than tepals. Capsule spherical, smooth, glabrous, (8) 10–12 mm in diameter. Seeds narrowly winged, gray. Fig. 31.

Flowering: June–July.

Fruiting: July–August.

Ecology: In the middle zones of the mountains; altitude up to 2000 m.

General distribution: Central Asia (Tien Shan, Pamir-Alay): Kazakhstan, Kyrgyzstan, Tajikistan, Uzbekistan.

Distribution in Uzbekistan: suppl. file 29.

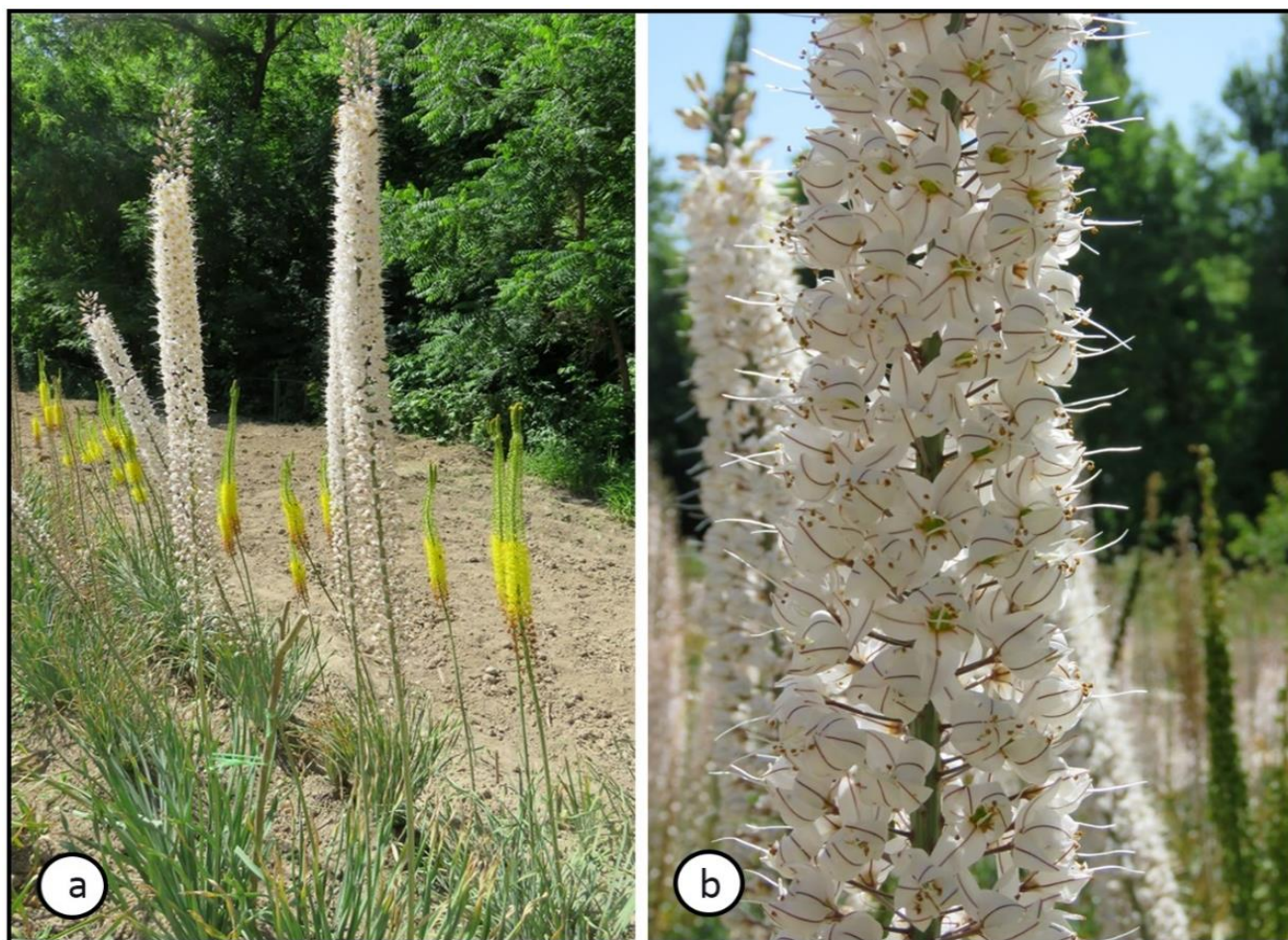


Fig. 31. *Eremurus tianschanicus*, a: general appearance, b: inflorescence. Photos by Natalia Beshko.

(20) *Eremurus korolkowii* Regel

in Trudy Imp. S.-Peterburgsk. Bot. Sada 3(2): 116 (1875). — *Henningia korolkowii* (Regel) A.P. Khokhr., in Erem. Cult.: 94 (1965).
 Type: Uzbekistan, in Turkestan near the well of Sultan-Bibi, in the hills of Kuldschuktau, in sandy loam, Korolkow (holotype LE).

Scape 20–40 cm tall, leaves glaucous, entire; raceme initially dense, then looser, 5–25 cm long; pedicels filiform, continuous, spreading, bracts narrowly linear-lanceolate, smooth hyaline-white with a villous margin, then 1/3 larger, shorter at the beginning; capsule spherical to appear shaggy. Fig. 32.

Flowering: April-May.

Fruiting: May.

Ecology: On gravelly soil, sometimes sandy (Fig. 32).

General distribution: Central Asia: Uzbekistan.

Distribution in Uzbekistan: suppl. file 30.

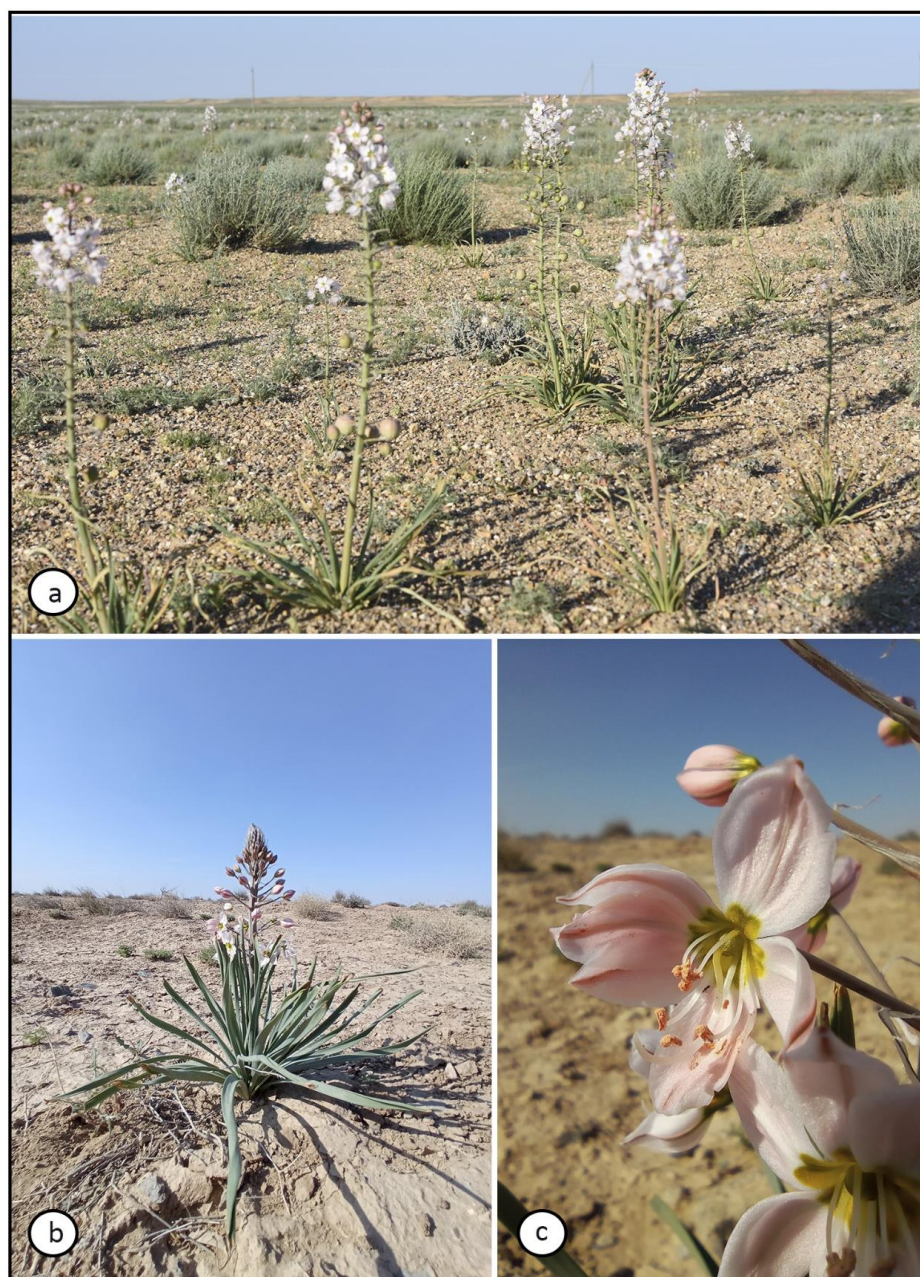


Fig. 32. *Eremurus korolkowii*, a: habitat, b: general appearance, c: flower. Photos by the authors.

(21) *Eremurus aitchisonii* Baker ex Aitch.

in J. Linn. Soc., Bot. 18: 102 (1880). — *Henningia aitchisonii* (Baker) A.P. Khokhr., Erem. Cult.: 95 (1965).

Type: Afghanistan, Karchatal and at Drekalla, on ridges of the hills from 11000 to 12000 feet, 15.06.1879, Aitchison 596 (Holotype K).

= *Eremurus elwesianus* Krelage, Nursery Cat. (Krelage's Bulbs) 472B: 101 (1894), (holotype unknown).

Scape 70–120 cm tall, glabrous or more often at the base rough-fluffy. Roots spindle-shaped thickened, 1–1.5 cm thick. Leaves broadly linear, outer 3–5 (8) cm wide, bright green, broadly grooved above, almost flat, winged-keeled below, glabrous. Raceme loose, relatively few-flowered, cylindrical, 20–45 cm long. Bracts triangular-lanceolate, long drawn, shaggy-ciliated. Pedicels horizontally deviated, the lower ones are twice as long as the perianth, with fruits about 1.5 mm thick. Tepals 2–2.4 cm long, with 1 vein, pink, at the very base with a yellow spot, external oblong, almost 2 times narrower than internal, broadly elliptic. Stamens

1.5 times shorter than the perianth. Capsule spherical, 1.5–2 cm wide. Seeds with oblique wide wing. Fig. 33.

Flowering: May–June.

Fruiting: June–July.

Ecology: In the lower part of the zone of black forest, rarely in the upper part of the zone of shiblyak and semi-savannas; altitude 1600–3000(3200) m.

General distribution: Afghanistan, Pakistan, Central Asia (Tien Shan, Pamir-Alay): Kyrgyzstan, Tajikistan, Uzbekistan.

Distribution in Uzbekistan: suppl. file 31.



Fig. 33. *Eremurus aitchisonii*, a: general appearance, b: inflorescence. Photos by the authors.

(22) *Eremurus robustus* (Regel) Regel

in Gartenflora 22: 257 (1873). — *Henningia robusta* Regel in Bull. Soc. Imp. Naturalistes Moscou 41(1): 457 (1868).

Type: Kazakhstan. In the foothills of Talgar in the Alatau transiliensis, at an altitude of 2000-3000 feet, 1868, col. Semenow, no. 1092 (holotype LE).

Scape 100–200 cm tall, rarely 400 cm long and is thick (up to 22 mm thick.), cylindrical, bare, somewhat bluish. The roots fleshy, thick, cylindrical, longer than all other species of the genus *Eremurus* (up to 150 cm long). Leaves are thick (up to 22 mm thick.), cylindrical, glabrous (bare), somewhat bluish, up to 75 cm long., 7 cm wide, rough on the margin. Raceme dense, very long and multi-flowered (up to 800 flowers). Bracts linear from extended base, densely woolly-hairy. Pedicel straight, protruding, with connection on top. Perianth broadly subrotate, up to 2 cm in diameter. Lobes pink, pale pink

(var. *pallidus* O. Fedtsch.), less often white (var. *candidus* O. Fedtsch.), lanceolate, internal wider. Filament stamens equal in length to the perianth. Ovary yellowish, smooth. Capsule globose, about 2 cm in diameter. Seeds gray, wide-winged. Fig. 34.

Flowering: May-June.

Fruiting: May-June.

Ecology: Mountain meadows (Fig. 34).

General distribution: Central Asia (Tien Shan, Pamir Alay): Kazakhstan; Kyrgyzstan; Tajikistan; Uzbekistan.

Distribution in Uzbekistan: suppl. file 32.

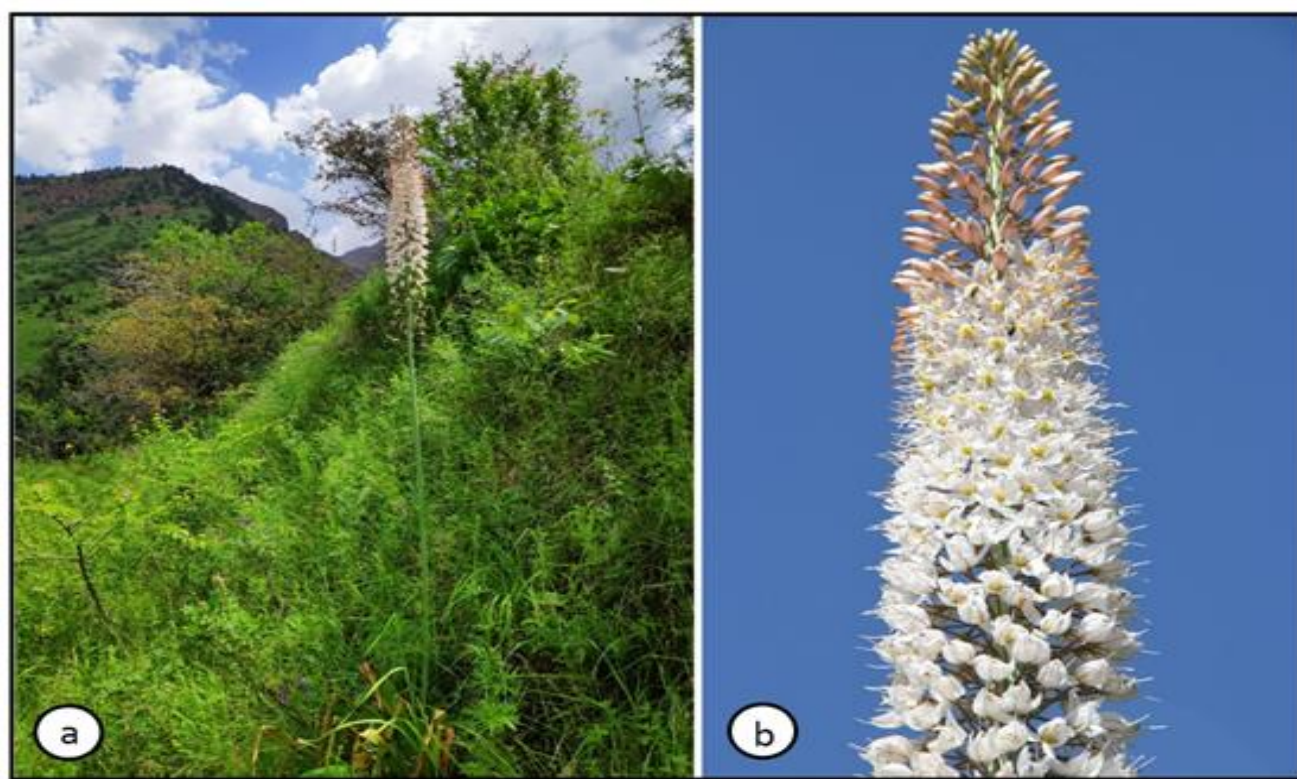


Fig. 34. *Eremurus robustus*, a: habitat and general appearance, b: inflorescence. Photos by Natalia Beshko, www.plantarium.ru.

Conflict of interest

The authors declare that there is no conflict of interest.

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References

- APG IV (2016) The linnean society of London, Botanical Journal of the Linnean Society. 181: 1-20.
- Bredenkamp CL (2019) A flora of the Eastern Cape province. A flora of the Eastern Cape province.
- Dhiraj S, Anjna DLsL (2011) Traditional health practices by 'kinners'-A tribe in alpine and sub-alpine himalayas of Kinnaur (Himachal Pradesh), India, Department of botany, Rajkiya Kanya Mahavidhalaya, Shimla (HP). *Life sciences Leaflets* 22: 1048-1055.
- Eker I (2020) Eremurus M.Bieb. In: Guner A, Kandemir A, Menemen Y, Yıldırım H, Aslan S, Eksi G, Guner I, Cimen A, Sen F (eds), The Illustrated Flora of Turkey web version. ANG Foundation Nezahat Gökyiğit Botanik Bahçesi Publications, Istanbul.
- Farris JS (1969) A successive approximations approach to character weighting. *Systematic Biology* 18: 374-385.
- Fedchenko O (1968) Eremurus: kritische Übersicht über die Gattung. Cramer.
- Fedtschenko B (1935) Eremurus M.Bieb. In: Komarov V (ed), Flora of the USSR. USSR Acad. Sci., Leningrad, pp. 37-52.
- Felsenstein J (1985) Confidence limits on phylogenies: an approach using the bootstrap. *Evolution* 39: 783-791.
- Goloskokov V (1958) Eremurus. In: Pavlov N (ed), Flora of Kazakhstan. Acad. Sci. KazSSR, Almaty, pp. 109-117.
- Hagedorn G, Rambold G, Martellos S (2010) Types of identification keys. Tools for Identifying Biodiversity: Progress and Problems. EUT Edizioni Università di Trieste, pp. 59-64.
- Kamenetsky R, Rabinowitch E (1999) Flowering response of Eremurus to post-harvest temperatures. *Scientia horticulurae* 79: 75-86.
- Kashenko L (1951) Eremurus. In: Vvedensky A (ed), Flora of Kirgizii. Kirgiztan USSR, Frunze, pp. 29-36.
- Khassanov F (2015) Conspectus Florae Asiae Mediae 11. Science Publishers, Tashkent.
- Khokhryakov A (1965) Eremurusy i ikh kul'tura. [Eremuruses and its culture]. Nauka, Moscow.
- Kosenko V (1999) Pollen morphology in the family Asphodelaceae (Asphodeleae, Kniphofieae). *Grana* 38: 218-227.
- Lazkov G, Sultanova B (2014) Inventory of the flora of Kyrgyzstan: Vascular plants. *United Nations Development Programme*.
- Li W, Tojibaev KS, Hisoriev H, Shomurodov KF, Luo M, Feng Y, Ma K (2020) Mapping Asia Plants: Current status of floristic information for Central Asian flora. *Global Ecology Conservation* 24: e01220.

- Maddison W, Maddison D (2019) Mesquite: A modular system for evolutionary analysis, version 3.6. 2018.
- Makhmudjanov D, Yusupov Z, Abdullaev D, Deng T, Tojibaev K, Sun H (2019) The complete chloroplast genome of *Eremurus robustus* (Asphodelaceae). *J Mitochondrial DNA Part B* 4: 3366-3367.
- Naderi SK, KAZEMPOUR OS, ZAREEI M (2009) Phylogeny of the genus *Eremurus* (Asphodelaceae) based on morphological characters in the Flora Iranica area. *Iranian Journal of Botany* 15(1): 27–35.
- Perry P (1987) A synoptic review of the genus *Bulbinella* (Asphodelaceae) in South Africa. *South African Journal of Botany* 53: 431-444.
- Safar KN, Osaloo SK, Assadi M, Zarrei M, Mozaffar MK, Ecology (2014) Phylogenetic analysis of *Eremurus*, *Asphodelus*, and *Asphodeline* (Xanthorrhoeaceae-Asphodeloideae) inferred from plastid trnL-F and nrDNA ITS sequences. *Biochemical Systematics* 56: 32-39.
- Salehi B, Ayatollahi S, Segura-Carretero A, Kobarfard F, Contreras M, Faizi M, Sharifiad M, Tabatabai S, Sharifi-Rad J (2017) Bioactive chemical compounds in *Eremurus persicus* (Joub. & Spach) Boiss. essential oil and their health implications. *Cellular and Molecular Biology* 63(9): 1-7.
- Sennikov A (2016) Flora of Uzbekistan. Navro‘z Publishers, Tashkent.
- Sennikov A (2017) Flora of Uzbekistan. Navro‘z Publishers, Tashkent.
- Sennikov A (2019) Flora of Uzbekistan. Ma’naviat Publishers, Tashkent.
- Sennikov A, Tojibaev K, Khassanov F, Beshko N (2016) The flora of Uzbekistan project. *Phytotaxa* 282: 107-118.
- Seo S-W, Oh S-H (2017) A visual identification key to Orchidaceae of Korea. *Korean Journal of Plant Taxonomy* 47: 124-131.
- Simpson MG (2010) Chapter 1 Plant systematics: an overview. Academic Press.
- Swofford DL (2002) PAUP: phylogenetic analysis using parsimony, version 4.0 b10. Sinauer Associates, Sunderland, MA.
- Thiers B (2021) Index Herbariorum: a global directory of public herbaria and associated staff. New York Botanical Garden’s Virtual Herbarium. Accessed on 20 December 2020.
- Tojibaev K, Beshko N, Karimov F, Batoshov A, Turginov O, Azimova D (2014) The data base of the flora of Uzbekistan. *Journal of Arid Land Studies* 24: 157-160.
- Tojibaev K, Beshko N, Popov V, Jang C, Chang K (2017) Botanical geography of Uzbekistan. Republic of Korea: Korea National Arboretum, Pocheon.
- Tojibaev K, Khassanov F, Beshko NY, Karimov F (2019) The Red Data Book of the Republic of Uzbekistan. In: Khassanov F (ed). Chinor ENK, Tashkent, pp. 219-231.
- Tojibaev KS, Jang CG, Lazkov GA, Chang KS, Sitpayeva GT, Safarov N, Beshko NY, Muktubaeyeva SK, Vesselova PV, Turakulov IJP (2020) An annotated checklist of endemic vascular plants of the Tian-Shan Mountains in Central Asian countries. *Phytotaxa* 464: 117–158-117–158.
- Tosun M, Tosunl M, Ercisli S, Ozer H, Turan M, Polat T, Ozturk E, Padem H, Kilicgun H (2012) Chemical Composition and Antioxidant Activity of Foxtail Lily (*Eremurus Spectabilis*). *Acta Sci. Pol. Hortorum Cultus* 11: 145–153.
- Vvedensky A (1932) *Eremurus*. In: Fedtschenko B, Popov M (eds), Flora of Turkmenii. USSR Acad. Sci. and Bot. Ins. Turkm. USSR, Leningrad, pp. 250-257.
- Vvedensky A (1941) *Eremurus*. In: Kudryashev S (ed), Flora of Uzbekistan. Uzb. Sec. USSR Acad. Sci., Tashkent, pp. 398-410.
- Vvedensky A (1963) *Eremurus*. In: Ovchinnikov P (ed), Flora of Tadzhikistan. USSR Acad. Sci., Moscow-Leningrad, pp. 186-212.
- Vvedensky A, Kovalevskaya S (1971) *Eremurus*. In: Kovalevskaya S (ed), Conspectus Florae Asiae Mediae. Fan UzSSR Tashkent, pp. 14-27.
- Wendelbo P (1982) *Asphodeloideae: Asphodelus, Asphodeline & Eremurus*. In: Rechinger K (ed), Flora Iranica, pp. 3-31.
- Wendelbo P, Furse P (1969) *Eremurus* of South West Asia. *Lily Year Book* 32: 56-69.

Xinqi C, Songyun L, Jiemei X, Tamura M (2000) Liliaceae. In: Wu Z, Raven P (eds), Flora of China. Beijing and St.Louis (MO): Science Press and Missouri Botanical Garden Press, pp. 73-263.

Zhou J, Xie G, Yan X (2010) Encyclopedia of Traditional Chinese Medicines: Molecular Structures, Pharmacological Activities, Natural Sources and Applications. Volume 3. Springer, Berlin, Heidelberg, pp. 53.

Appendix 1. Locality information for fresh materials used in this study.

Species	Location	Altitude (m)	Latitude (N)	Longitude (E)	Date of collecting	Collectors
<i>E. indierensis</i>	Near Bukhara-Khorezm Highway, Khorezm, Uzbekistan	161	41.068596	61.974243	03.05.2019	Abdullaev D., Makhmudjanov D.
<i>E. altaicus</i>	Ungor, Yangikurgan, Namangan, Uzbekistan	1450	41.261527	71.423118	18.05.2019	Karimov F. Makhmudjanov D.
<i>E. soogdianus</i>	Majrum, Nurata, Uzbekistan	1064	41.287041	71.524147	02.05.2021	Yusupov Z., Makhmudjanov D.
<i>E. regelii</i>	Kamchik pass, Pop, Namangan, Uzbekistan	1441	41.139118	70.457115	02.05.2021	Yusupov Z., Makhmudjanov D.
<i>E. iae</i>	Vakhshivar, Denou, Surkhandrya, Uzbekistan	2007	38.354355	67.597321	02.06.2019	Juramurodov I., Makhmudjanov D.
<i>E. korolkowii</i>	Around the Botanical station, Kyzylkum desert, Bukhara, Uzbekistan	444	40.712597	63.737015	16.04.2021	Dekhkono D., Makhmudjanov D.
<i>E. kaufmannii</i>	Guralash, Jizzakh, Uzbekistan	2172	39.679432	68.304537	04.06.2019	Juramurodov I., Makhmudjanov D.
<i>E. baissunensis</i>	Baisun, Surkhandrya, Uzbekistan	1193	38.198219	67.248489	25.03.2021	Dekhkono D., Pulatov S., Makhmudjanov D.
<i>E. alberti</i>	Babatag, Chagam, Surkhadarya, Uzbekistan	721	38.163429,	68.112976	26.03.2021	Dekhkono D., Pulatov S., Makhmudjanov D.
<i>E. pubescens</i>	Chaknak, Denou, Surkhandrya, Uzbekistan	1213	38.531013	67.586830	30.03.2021	Turginov O., Dekhkono D., Makhmudjanov D.