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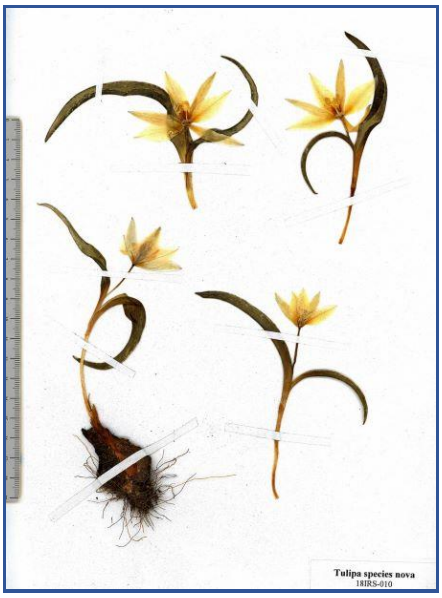
As the craziness in the wider world continues, those amongst us with a love of plants and nature have had some chance to divert our attention to the plants in our care or the beauty still to be found in landscape around us. Would that more humans were as interested in all aspects of the natural world and the survival of its magnificence! Even a plant-based magazine such as the International Rock Gardener is affected by the likes of the Corona Virus pandemic and the world's warring factions – we can only hope that those authors and readers most affected by recent military infractions will soon be free and able to share their knowledge with us once more. Our thoughts are with all who are suffering at this time.

In this edition of IRG, two new *Tulipa* species from sect. *Biflores* (subgen. *Eriostemones, Liliaceae*) are described from the Zagros Mountains of Iran, and Zhetysu, Kazakhstan, from Dr Janis Rukšāns (Latvia) and Dr Dimitri Zubov (Ukraine), who are both passionate scholars of geophytic plants. Following that is an article on the lovely *Saxifraga ludlowii* from the famed Czech plantsman, Vojtěch Holubec. Vojtěch was awarded the Lyttel Trophy by the Alpine Garden Society in 2010 -their premier award and one which was also made to the Father of the IRG, Zdeněk Zvolánek in 2020. Finally this month there is a review of a new book which is surely going to become a "must have" for all people with a passion to grow plants in a fashion which really suits them! We have eagerly awaited this book by Kenton Seth and Paul Spriggs and its arrival has fulfilled all our most demanding expectations of it. There is much in it to be useful to any plant lover and the rigour devoted to its production is remarkable. The IRG Team is certainly impressed by it!

Cover image: *Saxifraga ludlowii* grown (in the Tromsø arctic-alpine botanic garden from seed coll. Tibet Rawu 5000m) and photographed by Martin Hajman.



Two new *Tulipa* species from sect. *Biflores* (subgen. *Eriostemones*, *Liliaceae*) described from Iran, Zagros Mountains and Kazakhstan, Zhetysu (all photos & maps by J. Rukšāns, unless otherwise noted)

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Summary. Two new tulip species from sect. *Biflores*, subgen. *Eriostemones*, growing wild in Iran and Kazakhstan are described and illustrated; the differences between segregates of *Tulipa biflora* agg. (*Tulipa biflora s.s.* & *Tulipa kolbintsevii*) are discussed. Photographs and distribution maps are provided.
Key words. Geophyte, tulips, species aggregate, taxonomical species, microspecies, Zhetysu geographic area, Kazakhstan flora, Zagros Mountains, Flora Iranica.

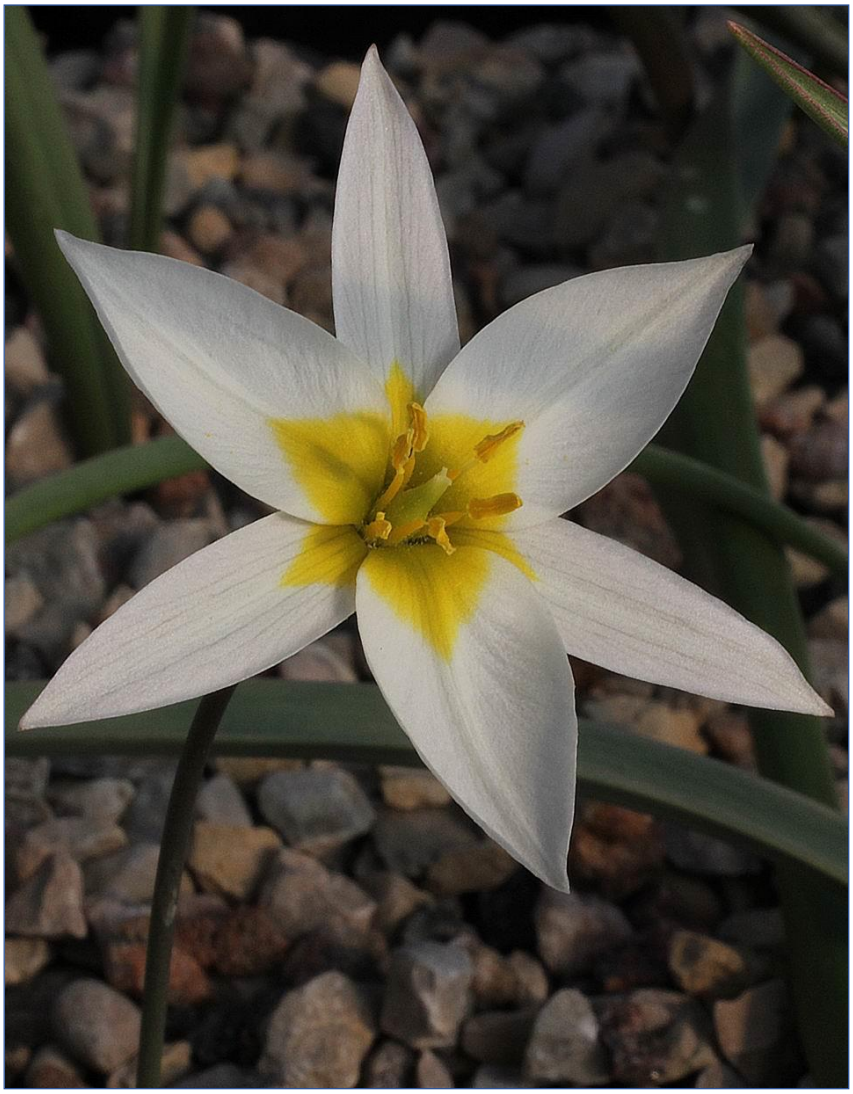
Introduction

The genus *Tulipa* L. has always proved a great challenge to botanists. John Gilbert Baker divided all tulip species into 2 groups – *Eriostemones* and *Leiostemones* [1-3]. Later in 1884 they were redesigned by Pierre Edmond Boissier as subgenera [6]. The group splitting is based on hairy and swollen basal part of filaments in *Eriostemones*, and nude without swelling filaments in *Leiostemones*. After Baker and Boissier there were several revisions in taxonomy of the genus *Tulipa*. The most important were those of Aleksei Vvedensky [33-35], a Russian taxonomist, florist, and researcher of the flora of Central Asia, Sir Alfred Daniel Hall [19], Zinaida Botschantzeva, a Soviet and Russian botanist, cytologist, embryologist, and professor of the Tashkent University of Uzbek SSR [7].

The number of recognised species varied greatly from 50-60 by van Raamsdonk & De Vries [31], ~100 by Hall [19] and Botschantzeva [7], but a Soviet tulip breeder Zinaida Silina, who worked in Leningrad (Petrograd) in the Botanical Garden of the Botanical Institute of the Academy of Sciences of the USSR, accepted in her review of the genus *Tulipa* 109 species [29]. There were several later publications about the genus, one of the most important was published in 2009 by Ben J.M. Zonneveld, who accepted 87 species [37], although the

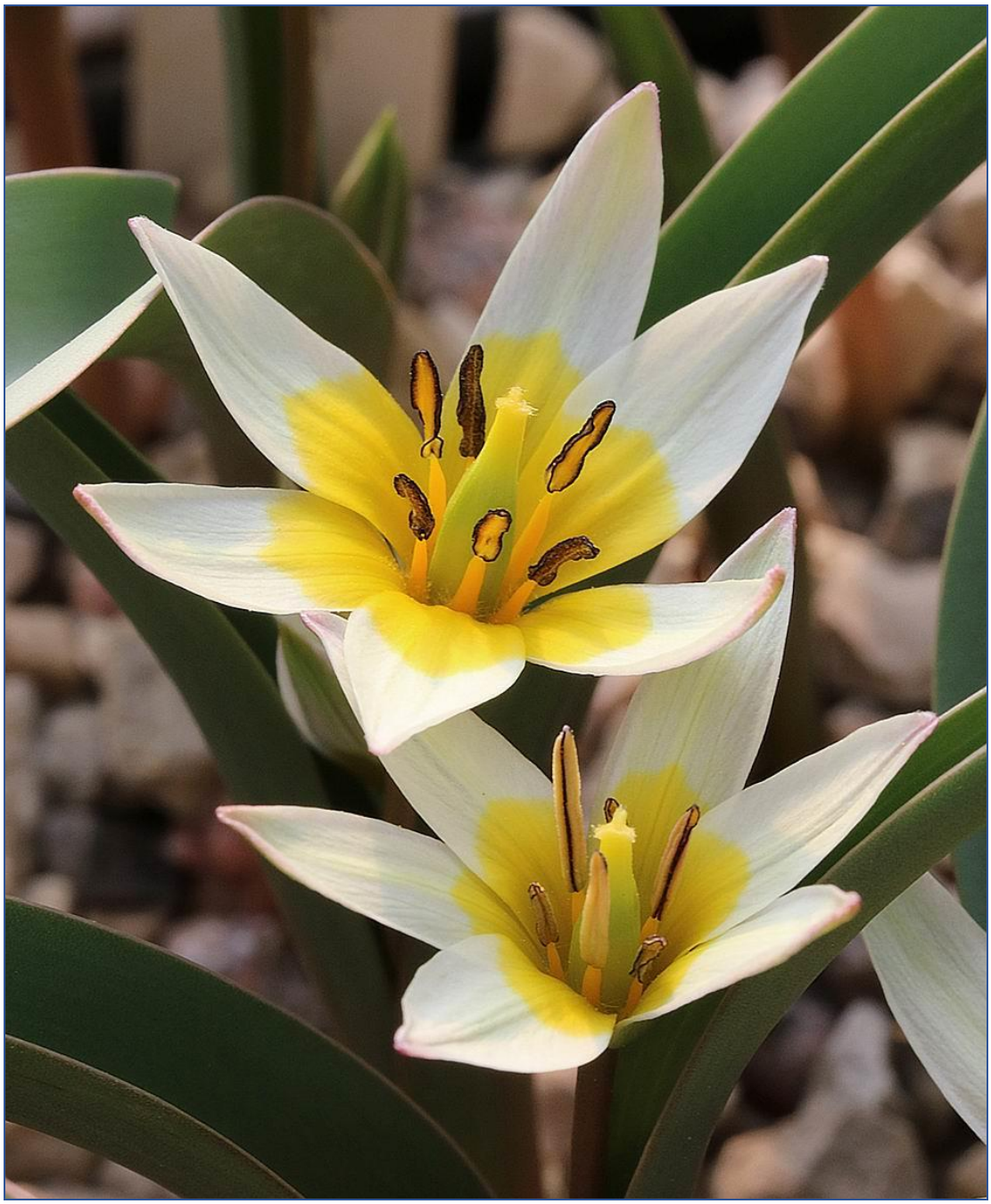
validity of names was corrected 2 years later by Veldkamp & Zonneveld [32]. The last and most complete genus revision was published in 2013 by Diana Everett from Kew Gardens, UK [13]. In the monograph she described and illustrated by photos and colour drawings all tulip taxa known at the time of publishing, although, following a pressure of editors from Kew Gardens, many species were presented as synonyms, which might be wrong. Also, M.F. Fay et al. within their phylogenetic project accept only 78 species [14].

A Dutch tulip researcher and grower Sjaak de Groot in his letter to Jānis Rukšāns wrote in 2020: “A lot of unnamed species from Iran are hidden under different names, thanks to the lumpers”. One of such a species – *Tulipa brinkii* J.J. de Groot & B.J.M. Zonneveld, found in the Kuh-e-Aladag in NE Iran, was recently published in IRG [11]. There are no consequences in this attitude, which to consider as a ‘true’ species and which only as a synonym (conspecific taxa). For example, in 1971 A. Vvedensky published a taxon of *T. prolongata* Vved. from South Tajikistan [34] giving as a main feature separating it from similar species a long neck of bulb tunics, reaching ground surface. It is a practically unknown species which was never introduced in cultivation and not seen *in situ* in the wild by later tulip explorers. In the monograph of D. Everett, it was included as a synonym of *T. biflora* Pall. [13]. Moreover, in 2012 Ben Zonneveld described *T. kolbintsevii* Zonn. (Dzungarian Alatau, E Kazakhstan) [36] and in 2015 – *T. jacquesii* Zonn. (the Chatkal range, Tien Shan, W Kyrgyzstan) [38], both having the same prolonged bulb tunics as in Vvedensky’s *T. prolongata*.

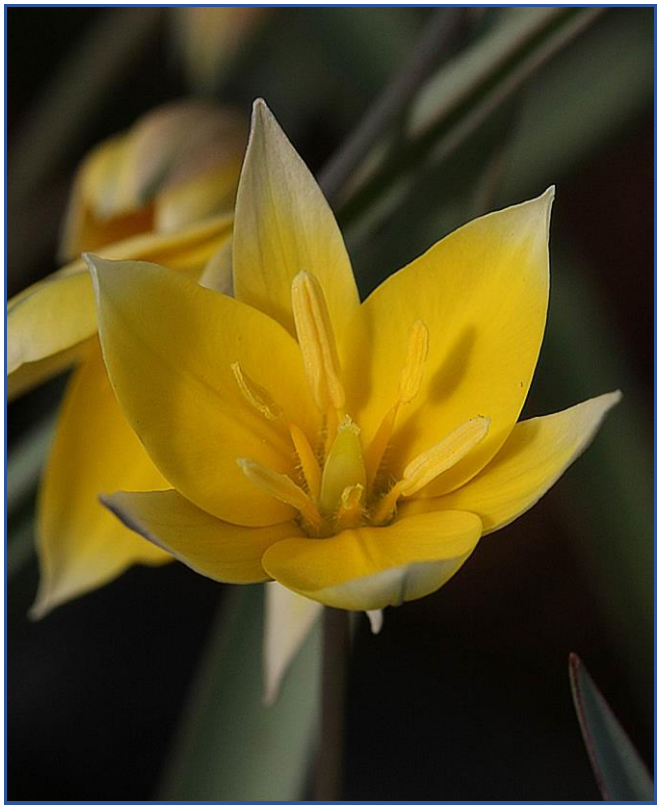
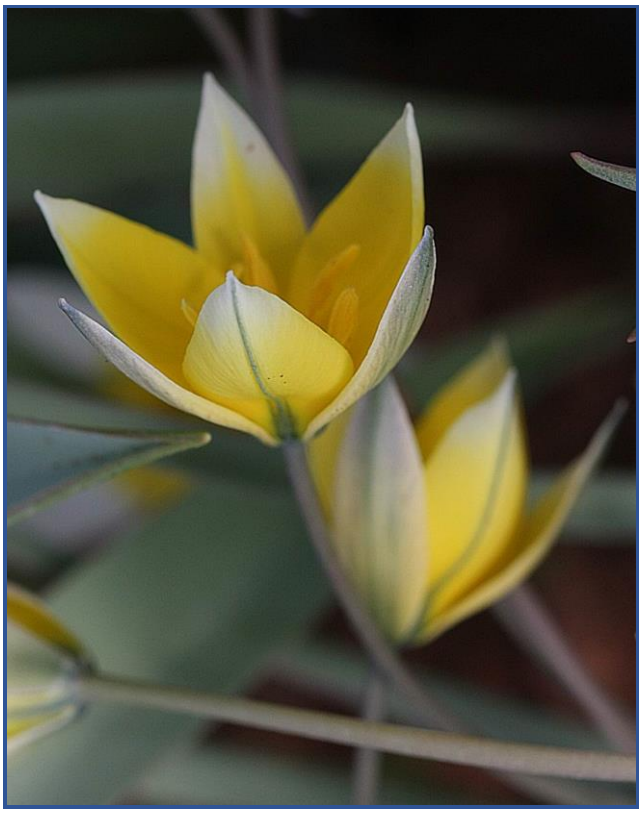


Tulipa kolbintsevii (12KZ-073), cultivated, from the *locus classicus*, E Kazakhstan.

Studying *T. kolbintsevii* for the first time in 2012 in SW Kazakhstan *in situ*, we initially identified it as *T. prolongata*, just for its specific-looking bulb tunics; and only great distance between both localities gave some doubt about the correctness of the name, but *T. kolbintsevii* in Everett's monograph is included as a valid and accepted species [13]. The only reason for such a different attitude could be availability of both taxa for exploring thoroughly. We highly suppose that they were not seen to compare by the mentioned authors in case of *T. prolongata* vs *T. kolbintsevii* (although even photo and description of *T. prolongata* are given in an original book on tulips of Central Asia written by A. Sharipov & J. Pratov from Tashkent Botanical Garden [28]).



Tulipa orithyioides, cultivated, from the *locus classicus*, Sina, SE Uzbekistan

Tulipa subbiflora, cultivated, from the *locus classicus*, Shachimardan vill., Khalqabad region, S Uzbekistan.

Similarly, *T. subbiflora* according to D. Everett [13] (following [9]) is included in synonyms of *T. orithyioides*. Attached photo of *"T. subbiflora"* from A. Seisums (*pers. comm.*) really isn't and it represents some other species. Even by this photo, it can be seen that the pictured plant hasn't prolonged style between ovary and stigma. But exactly that feature was used by A. Vvedensky to separate *T. orithyioides* from its allies [34]. *Tulipa orithyioides* was collected near its *locus classicus*, on Chulbair Ridge, Uzbekistan, by A. Seisums together with J. Rukšāns (ARJA-9814) and its morphological features were validated. *Tulipa subbiflora* was also collected by A. Seisums in its *locus classicus,* Alay Ridge, Kyrgyzstan, upper course of river Dugova, near Shachimardan village (Map 1; see photos of both species grown from J. Rukšāns' collection). So, under no circumstances should *T. subbiflora* be included into the synonyms of *T. orithyioides*. As an aside, A. Vvedensky was very keen botanist and usually all species published by him were later confirmed by other researchers. For Caucasus territory Alexander Grossheim listed only *T. polychroma* Stapf [18], which was placed by some later authors in synonyms of *T. biflora* [9, 13].

The last phylogenetic studies [9, 14] identified four independent lineages within *Tulipa*, corresponding to four subgenera: *Tulipa*, *Clusianae*, *Orithyia,* and *Eriostemones*. Ben Zonneveld [37] divides all *Eriostemones* species into 3 sections: *Sylvestres* (Baker) Baker,

Saxatiles (Baker) Baker, and *Biflores* A.D. Hall ex Zonn. & Veldk., consisting of 13 species (mostly from Central Asia) and 4 samples from Kazakhstan identified as *species novae* [37]. Tulip species from sect. *Biflores* have whitish yellow flowers, mainly differing in the number and consequently size of the flowers on a stalk. *Tulipa regelii* Krasn. was placed in a separate sect. *Lophophyllon* by A. Vvedensky based on its unique ridges on the 'velvet leaf' [34]. However, based on DNA content and flower morphology, Ben Zonneveld allocated it to sect. *Biflores* [37].

Tulipa regelii, cultivated, from the Chu-Ili Mountains, SE Kazakhstan.

Species of subgen. *Eriostemones* and especially from sect. *Biflores* are superficially quite similar in many cases and only careful observation of minor morphological characters allows their step-by-step identification.

Unfortunately, only a few monograph authors give keys for identification of tulip species. Such keys are lacking in monograph of Z. Botschantzeva [7] and in the last one of D. Everett [13]. Most complete key (*fide auct.*) is given by Z. Silina [29] and relating to tulip species growing wild in former USSR and later in Central Asia – by A. Vvedensky [33-35; **see Suppl.**

1 & 2]. All other published keys cover smaller geographical areas in local Floras or are outdated by later studying. Comparing various keys, we find them quite contradictory, e.g., when determining the different keys, you will receive different taxa in results. It is especially complicated for the identification of *Tulipa* species from the subgen. *Eriostemones*, because in the original publications of 'the new species', there are often lacking the important morphological features allowing the separation of morphologically related taxa. Sometimes the herbarium type specimens are missing, or they are often poorly preserved that leads to impossible diagnostics, e.g., the bulbs and their tunics are always not well maintained. Of course, generally, the easiest way to resolve this problem is in lumping under one "hat" many morphologically different and often allopatric species, e.g., cryptic species (recently, *a cryptic species definition* was suggested for those species which manifest low morphological, but considerable genetic, disparity [25]).

It is interesting to note, that nearly all botanists can be divided into two basic groups (the third group is formed by so named "politics-botanists", whose opinion swings like weathervane, although sometimes they dominate, we hope that it is only a temporary occurrence). There are botanists who could be named as "cabinet botanists" – they mostly work on herbariums gathered by "field botanists", who work in the wild. The first type were well characterized by W. Blunt in his novel "Of Flowers & a Village" [5]: "There was Benjamin Robinson, the American botanist, who when asked to identify a wild flower always replied, 'Press it, dry it, bring it back, and I'll name it for you'." Of course, field botanists, who observe plants *in situ*, know them far better, as they can see smallest details, which sometimes are hidden in pressed plants which often losing their original colour *in exsiccatae*. For example, in Flora of USSR the Siberian *Eranthis* species is characterized by having yellow flowers only by reason of dried flower colour change in herbaria, although really they are all white-flowered species (e.g., *Eranthis sibirica* DC, *E. stellata* Maxim.).

The published species description is not always the same in different botanic literature. For example, going through pictures and descriptions of subgen. *Eriostemones* tulips in different publications and floras we found that descriptions of the same species vary. For example, Vvedensky and Silina characterise *T. dasystemon* (Regel) Regel and *T. dasystemonoides* Vved. as both having fully yellow flowers, but on pictures and in description, given by Everett for *T. dasystemonoides*, their flowers are white or white with yellow centre. In reality, they are only whitish at the beginning of anthesis, and the next day they turn bright yellow [29, 33]. Botschantzeva however, does mention one gathering of *T. dasystemon* from The Greater

Chimgan Mountain (Uzbekistan) with white flowers and pleasant smell [7]. *Tulipa talijevii* Klokov & Zoz is listed by Everett [13] among synonyms of *T. biflora,* but Christenhusz et al. [9] consider it as synonym of *T. sylvestris* L. *Tulipa halophila* Bornm. & Gauba is regarded as synonym of *T. biflora* by Govaerts and Everett [13, 16, 21], but in the herbarium type sheet Per Wendelbo attached a note, that it is *T. buhseana* Boiss., another very variable species, under which name several different taxa hide, and it is easily separable from other "*bifloras*" by extremely coriaceous, even ligneous bulb tunics. Plants of "*T. buhseana*" from Kyzyl-Kum desert collected by A. Seisums and J. Rukšāns (ARJA-0002) are quite different from plants collected under the same name from Ili river valley in Kazakhstan (12KZ-034 & 036), and those ones collected as well by Seisums & Voronin at Ashisu (VS-9417). It should be also noted, that D. Everett characterises *T. lemmersii* Zonn., Peterse & J. de Groot [32], described from S Kazakhstan, as having thin bulb tunics, but it really has hard and thick tunics and also a long tunic neck (*pers. observ. & private letter* from Sjaak de Groot, one of the taxon authors, to J. Rukšāns).

Another problem is in an interpretation of morphological characters. Each observer can differently characterize the same plant, so it would be ideal situation if the same person were to travel through all area of related species and observe them in nature. Unfortunately, when authors could travel through all Soviet Central Asia without borders, visas and political restrictions, our interests were more directed to other plants, but tulips had only occasional interest and gatherings. Nowadays, such trips within former USSR's Central Asian republics are much more difficult to realize.

Any species should be characterised as far as possible using as many parameters as possible. The easiest way to compare various tulip accessions is cultivating them, side by side, under identical agricultural conditions. This allows us to avoid influence of natural vagaries: dry or wet seasons, temperature fluctuations, etc. In this aspect we oppose Kerndorff et al. [24] who regard the parameters from cultivated plants as not reliable. In the wild plants suffer or benefit from insolation conditions, the whims of weather, and nutrient availability in the same way as in culture. Kerndorff et al. stated [24]: *"Climatic factors, respectively weather conditions may change from year to year, but this has mainly only influence on the flowering time."* We think that it is not true. In the wild plants are periodically influenced by droughts, night frosts, as well as many other natural factors which affect the growing capacity on a regular basis. As in cultivation, in the wild they are not immune to the fungal, viral and bacterial diseases, they also struggle from pests, drought, hail, animal

grazing, occasional extra feed from cattle droppings, and hundreds of other causes. Mostly only from cultivated plants can we receive complete data for description of new taxa, including not only characters of flowering plants, but those fruiting and dispersing seeds as well. Only rarely is it possible to revisit remote corners twice a season to get all those characteristics. A lot of new species published by us were collected in the wild only looking at leaves and seen in flower only in cultivation, when they turned out to be new taxa.

Materials and Methods

Field studies for *T. salsola* were undertaken in May 2012 in south-eastern Kazakhstan (The Dzungarian Alatau: Zhetysu geographic area – a historical name of a part of Central Asia, corresponding to the south-eastern part of modern Kazakhstan; it means in Kazakh *"seven rivers/waters"*, to the rivers which flow from the south-east into Lake Balkhash), and living material (including seed grown progeny) in cultivation (Latvia) was examined by us between 2013 and 2021. Field studies for *T. lorestanica* were undertaken in Lorestan Province, western Iran (Zagros Mountains) in April 2016 and May 2018, and living material in cultivation (Latvia, Ukraine) was examined by us between 2017 and 2021. Herbarium specimens of other related tulip species were examined at LE, GB, BM, M, BGBM and K herbaria (abbreviations after [20]). Measurements, colours, and other details are based on living material, spirit and herbarium specimens and data derived from field notes. Morphological and anatomical examinations were made using a stereo microscope Stemi 2000-C and inverted microscope AxioObserver A1 equipped with digital camera AxioCamERc 5s and ZEN 2012 software (Carl Zeiss, Germany). Morphological terminology follows [4]. The distribution Maps 1, 2 & 3 were plotted and produced using specimens and recorded coordinates, verified using Google Earth Pro (©2017 Google). The preliminary conservation status of *T. salsola* and *T. lorestanica* was not evaluated against the Red List Criteria [22] due to the insufficient data of these two new species full-range distribution.

Tulipa salsola habitat: S Dzungarian Alatau: Zhetysu, E Kazakhstan.

Tulipa salsola *Rukšāns & Zubov* **sp. nov.** Type: Kazakhstan, Zhetysu region, extreme southern part of Dzungarian Alatau (44°10'N; 79°31'E); sandy, saline soils within semi-desert habitat, *c.* 880 m elevation; leg. 05 May 2012, *Rukšāns*; cult. (12KZ-059 specimen grown in J. Rukšāns garden, Latvia), fl. 11 Apr. 2021, *Rukšāns* s.n. (holotype: GB!).

Bulb: ovoid, elongated to the top, up to 15(–20, in cultivation) mm in diam. and 22-30 mm long.

Tunic: membranous, light to dull brown, adaxially at basal part nude, in upper third thinly covered with thin, more or less parallel hairs, becoming more densely in direction to the top, even dense and woolly at very top.

Leaves: 2, reclinated, arcuate, more or less reaching flower, canaliculate, glabrous, basal leaf up to 18(-20) mm wide and 18-19 cm long, second leaf up to 9 mm wide and 16-17 cm long, greyish green, glaucescent, sometimes with very thin, poorly expressed reddish margin, with age turns purplish abaxially.

Flowers: actinomorphic, 1-2 (-4 in cultivation), upright, stalks 15-21 cm high, brownish green to purplish, glaucescent.

Perianth segments: 6, in two trimerous whorls; *outer perianth segments* narrowly lanceolate to lanceolate, 30-37 mm long and 7-12 mm wide, creamy white with wide (half of segments width) slightly bluish grey mid-zone abaxially, with diffused yellowish basal blotch (from translucent inner basal blotch) at base, adaxially soft white with large (reaching 1/3 of segment length) bright yellow, narrowly triangular at top basal blotch, distinctly hairy at base and slightly papillose on edges up to half of segment's length or glabrous; *inner perianth segments* much wider, broadly lanceolate with pointed apex, up to 40 mm long and 24 mm wide with the widest part in lower 1/3 from base, soft white with translucent inner basal blotch and very thin greyish mid-vein up to the tips of segments abaxially, soft white with large yellow basal blotch reaching almost 1/3 -1/2 of segments length, rounded or widely triangularly pointed at the tip, at base densely hairy and mostly sparsely papillose along margins up to half of segment's length, rarely with glabrous margins adaxially.

Androecium: stamens 6, in two trimerous whorls, diplostemonous, inner stamens slightly longer than outer ones; filaments 6, 5-8 mm long, prolate-triangular, yellow, lighter at base, distinctly hairy along all length; anthers 6, 5-6 mm long, oblong-rectangular, yellow with a black point apex, of the same stigma level or lower.

Gynoecium (ovary and receptacle): syncarpous, tricarpellate; ovary superior, green, cylindrical, ±triangular in cross section, with darker ribs, papillose throughout; placentation

axile; style indistinct; stigma sessile, shortly trilobed, creamy, light yellow to light greenish, sometimes with dark spots, papillose.

Capsule: tricarpelate, sub-globous to cylindrical, up to 27 mm long and 14 mm wide, loculicidal, light greyish green with purplish ribs and pointed tips of carpels.

Seeds: brown, flattened with a narrow marginal wing, ±ovoid, 4-5 mm wide, in two rows per chamber (carpel), the seed coat made out of both integuments, but the testa is thin and the endosperm lacks starch, the embryo is small and visible.

Tulipa salsola fruiting in the wild: S Dzungarian Alatau: Zhetysu, E Kazakhstan.

Tulipa salsola fruiting in the wild: S Dzungarian Alatau: Zhetysu, E Kazakhstan.

Tulipa salsola bulb and bulb with opened upper tunic, in the wild: S Dzungarian Alatau: Zhetysu, E Kazakhstan.

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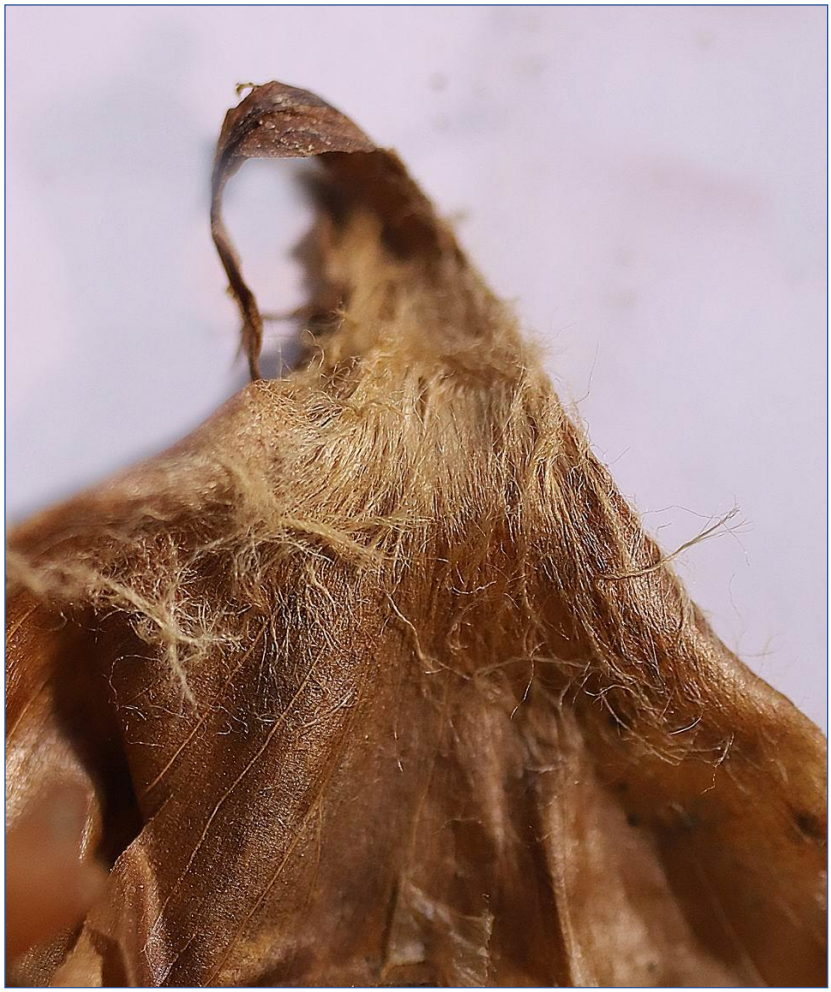

Tulipa salsola bulb tunic hairs, adaxial view.

Gynoecium & androecium details of *Tulipa salsola.*

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Cultivated plants of *Tulipa salsola* (12KZ-059)

Tulipa salsola seed pods, cultivated.

RECOGNITION.

Morphologically similar to *T. biflora s.s.* (*ex l.c.* – Volgograd vic.), but differs by having linear oblong-rectangular anthers 5-6 mm long, and stamens shorter or equal to ovary (*vs* sub-globous to ovoid anthers 3-4 mm long, and stamens longer than the ovary in *T. biflora s.s.*).

Morphologically similar to *T. kolbintsevii*, but differs by having 2(-3) flowers, greatly woolly bulb tunic at the neck adaxially, prolonged bulb tunic neck absent, and stamens shorter or equal to ovary (*vs* having 1 flower, glabrous, at the neck with some hairs bulb tunic adaxially, prolonged bulb tunic neck, and stamens longer than the ovary in *T. kolbintsevii*).

Distribution. Central Asia (Zhetysu): Kazakhstan, Panfilov District, Almaty Region (to south from Dzungarian Alatau, by the right bank of the Ili River); known only from the type locality. See Map 2**.**

Specimens examined. Kazakhstan, Zhetysu region, extreme southern part of Dzungarian Alatau; sandy, saline soils within semi-desert habitat, *c.* 880 m elevation; leg. 05 May 2012, *Rukšāns*; cult. (12KZ-059 specimen grown in J. Rukšāns garden, Latvia), fl. 11 Apr. 2021, *Rukšāns* s.n. (holotype: GB!). The exact locality of *T. salsola* has not been documented here for fear of unlawful plant collecting.

Habitat. Described from the extreme southern part of Dzungarian Alatau, where it is growing on fixed and hilly-ridged sands over brown and gray-brown soils, in depressions of takyrs and solonchaks with saxaul (*Haloxylon* Bunge *sp.*) and teresken (*Kraschenninnikovia ceratoides* (L.) Gueldenst. *cfr.*)-gray wormwood (*Artemisia cina* Berg ex Poljakov *cfr.*)-wheatgrass (*Agropyron* Gaertn. *sp.*) associations with sparse semi-desert/desert vegetation at *c.* 800-900 m elevation. Mesophyte, halophyte.

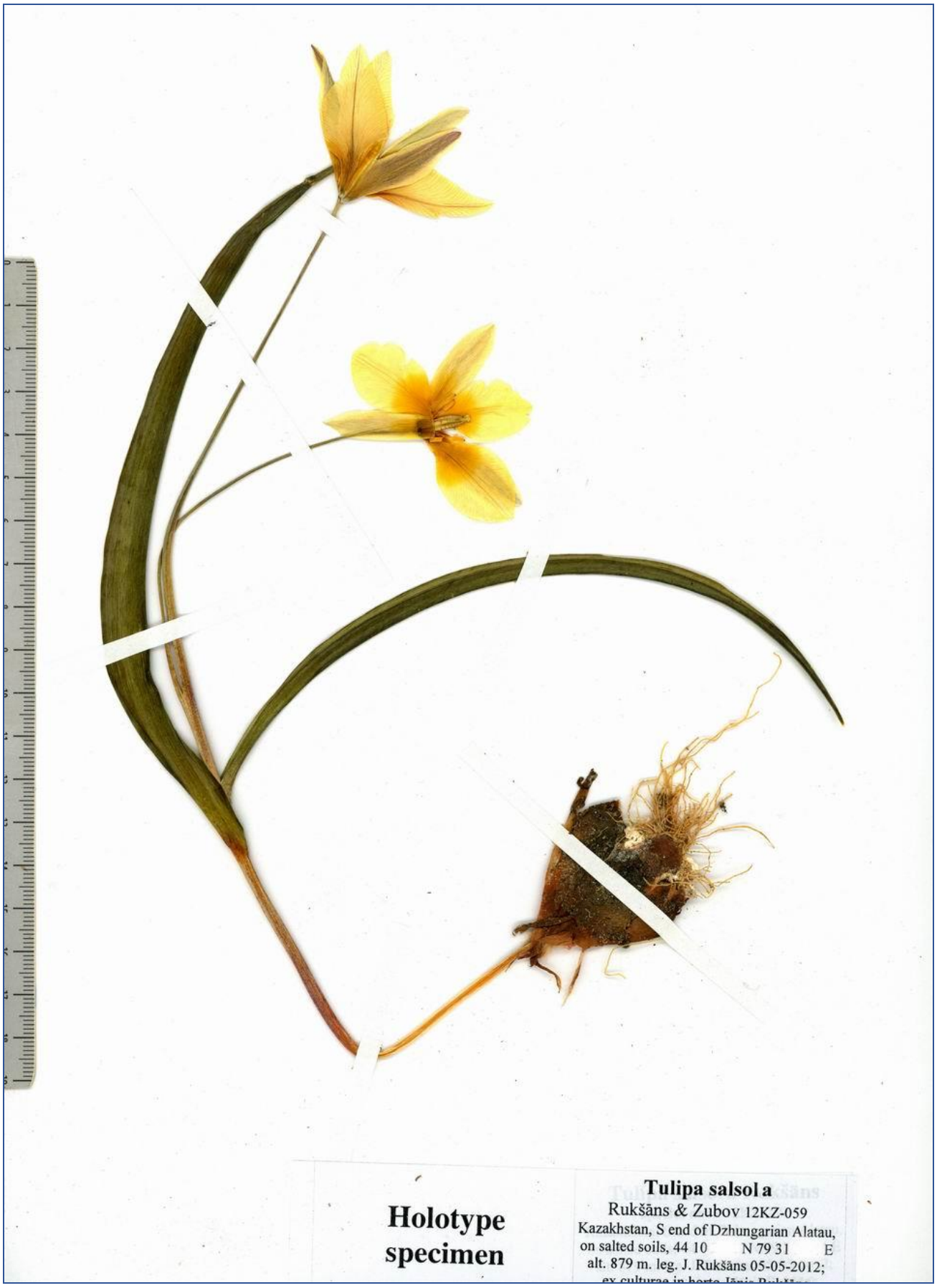
Conservation status. The preliminary conservation status of *T. salsola* was not assessed due to the insufficient data, but it could be informally evaluated between Vulnerable and Endangered [22] by known number of its locations in the wild (Map 2).

Phenology. Flowering: not seen in the wild, presumably since March; fruiting: May – June in the wild.

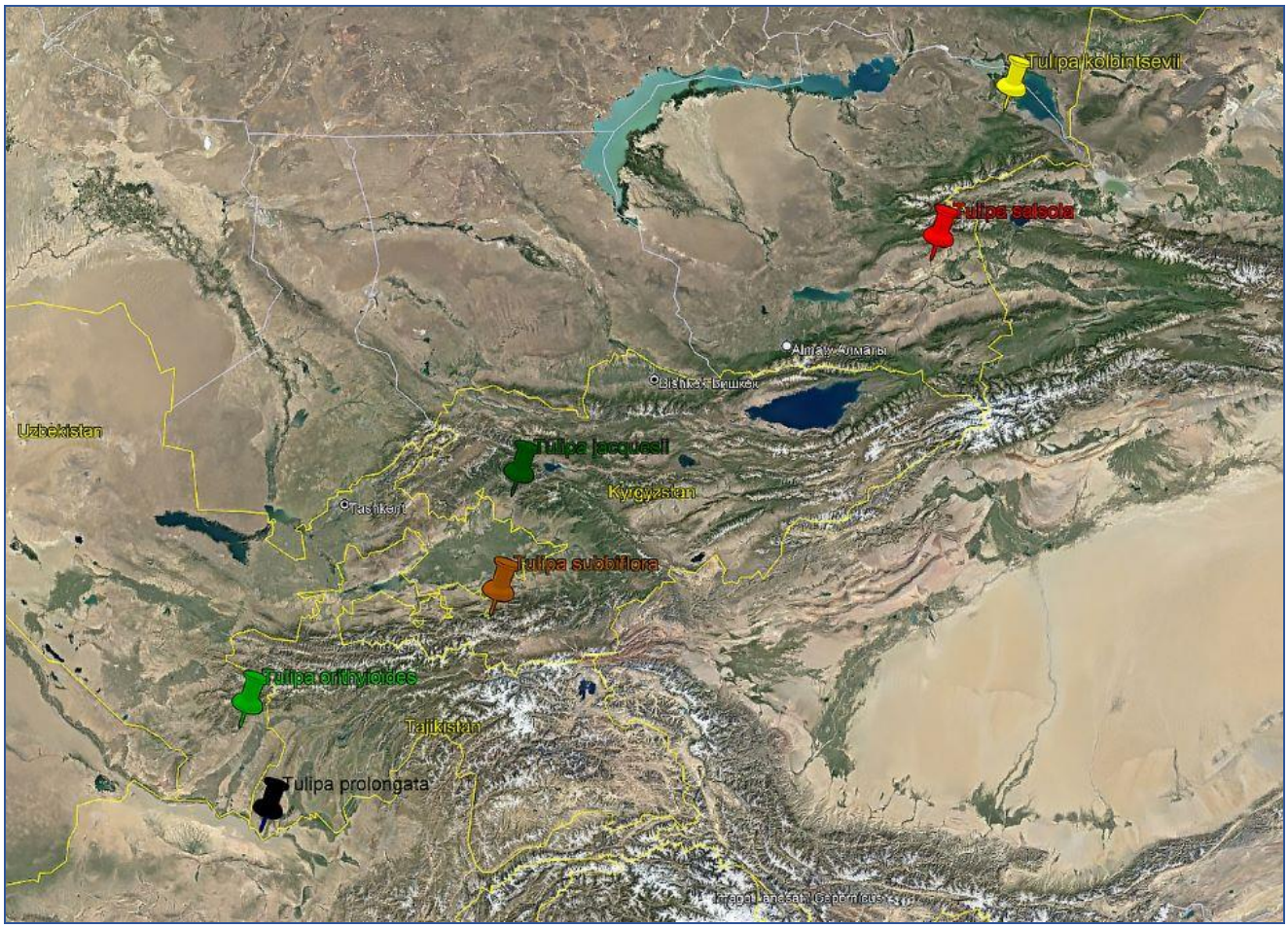
Etymology. The name means that newly described tulip predominantly grows in salted soils of takyrs and solonchaks.

Cultivation. *Tulipa salsola* isn't easy to cultivate, as it needs special agrotechnical treatment. When it is grown in traditional way for most tulips, it already starts vegetation and even blooming in December. J. Rukšāns is growing it in the same way as *T. regelii* and some other accessions of sect. *Biflores* tulips from Kazakhstan: planting them as late as possible and starting watering only at the end of December. Then it enters blooming at the end of February – March and plants do not suffer the lack of light.

[ED.: Takyrs and solonchaks are saline soil geomorphologic ground features of interdune depressions of the Central Asian deserts.]

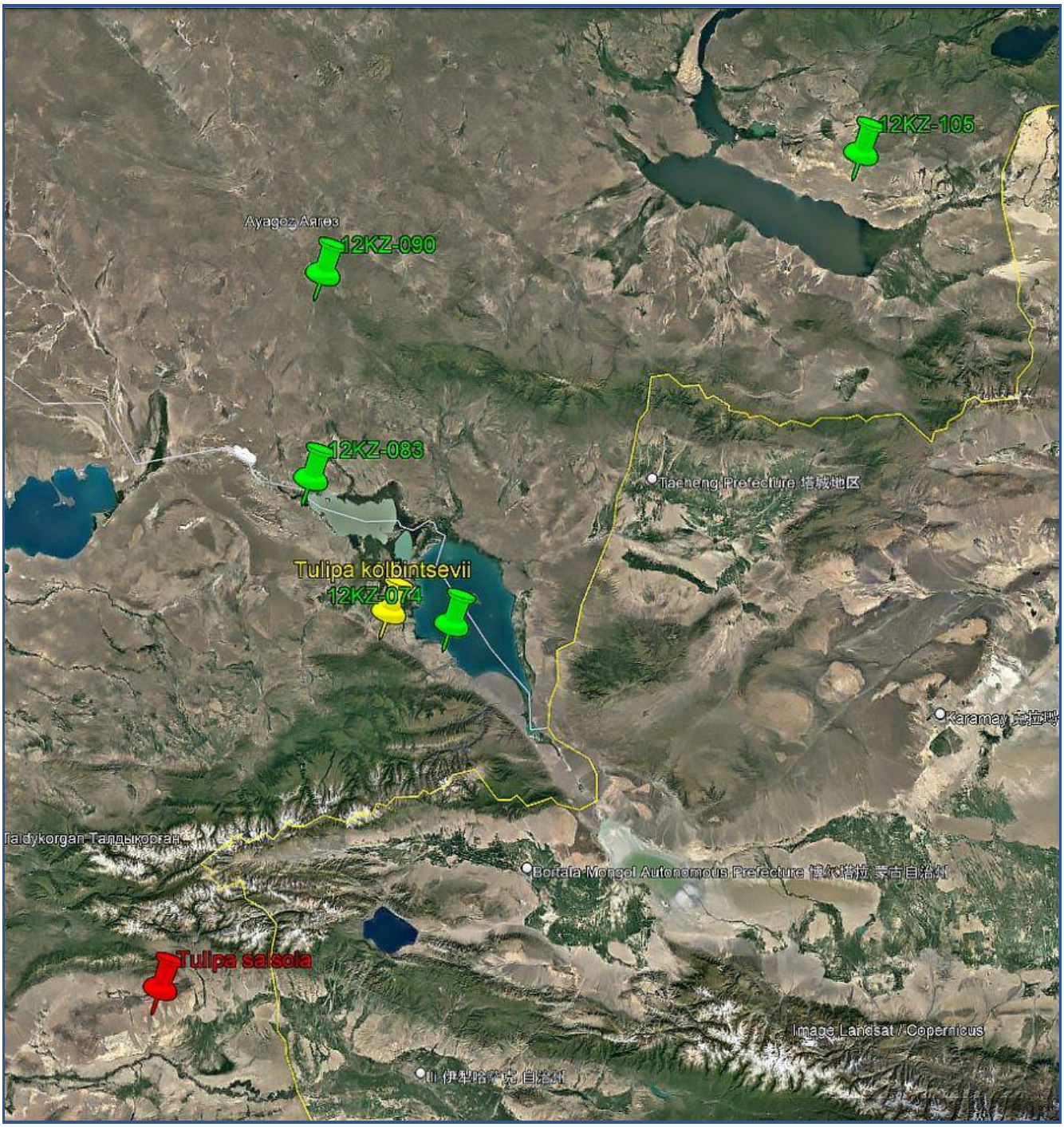


Tulipa salsola holotype deposited at GB.



Map 1: Localities of the little known subgen. *Eriostemones* tulip taxa from the former USSR Central Asian territory: yellow mark – *T. kolbintsevii*, red mark – *T. salsola*, dark green mark – *T. jacquesii*, brown mark – *T. subbiflora*, light green mark – *T. orithyioides*, and black mark – *T. prolongata.*

On Map 2 are marked the localities in Kazakhstan from where we observed tulip species considered by us as the *Biflores* tulips: red mark – *T. salsola*, yellow mark – *T. kolbintsevii*, and green mark – localities, where the *Eriostemones* tulips were observed and marked as *T. biflora cfr.* in our travel notes, but sufficiently distinct by morphology from *T. salsola* to be considered as different species within sect. *Biflores*. Another species from the *Biflores* tulips was observed in saline soil habitats and described from Iran (Persia borealis: Hügel von Raswandeh (Salzgebiete) in 1939 and named as *T. halophila* (salt-loving tulip). Unfortunately, its description lacks important details and we couldn't trace an exact locality from where in N Iran it was collected [9]. Regarding huge distance between Iran and Kazakhstan and high mountain ranges separating both localities, we consider them here as different species.



Map 2 – Localities of *Eriostemones* tulips observed during Kazakhstan expedition: red mark - *T. salsola,* yellow mark - *T. kolbintsevii,* green marks - another gatherings of *T. biflora s.l.* in Kazakhstan.

In the Flora Iranica, 1990 [27], 34 species of tulips are given in total in K. Rechinger treatment. From the sect. *Biflores* the author accepts the following species: *T. biflora* (all over Iran, incl. *T. polychroma*), *T. sogdiana* (C, E Iran), and *T. turcomanica* (NE Iran). Actually, we are happy to add to the sect. *Biflores* the new tulip species, endemic to Iran – *T. lorestanica* sp. nov. (ex W Iran: Zagros Mountains). Very similar to *T. lorestanica,* plants with a bit wider

and distinctly undulated leaves were found in March 2022 by Iranian bulb enthusiast Dr. Sajad Alipour at the border of Fars Province and Yazd Province (in Dehbid city vicinities) at *c.* 2400 m elevation. During the recent 2022 expedition to Iran, other morphologically similar tulips were found by Jānis Rukšāns in the northeast of Tabriz city (accession 22IRS-033: it has much wider and flat leaves) and within the eastern vicinity of Sanandaj city (accession 22IRS-104: it has narrow, but strongly undulated leaves, much more similar to Alipour's tulip found in the Dehbid city vicinities).

Tulipa lorestanica habitat in Zagros Mountains, Lorestan Province, W Iran.

Our team at *locus classicus* of *Tulipa lorestanica* (Gardaneh-ye Galeh Bādūsh Pass by Shool-Abad road, W Iran) during 18IRS expedition, May 2018: staying from left: Vaclav Jošt (Czech Republic), Alice Munsey (UK), Jānis Rukšāns (Latvia), John Graham (UK), Sholeh Jalili Khiabani (Iran), Martin Denney (UK), Henrik Zetterlund (Sweden), in front – Dimitri Zubov (Ukraine).

Tulipa lorestanica *Rukšāns & Zubov* **sp. nov.** Type: Iran, Lorestan Province, Zagros Mountains, Gardaneh-ye Galeh Bādūsh Pass by Shool-Abad road, between Chaal Gerd and Khorramabad (38°07'N; 49°25'E), on limestone screes between stone-chips; *c.* 2900-3000 m elevation, fl. 29 Apr. 2016, 16IRS-187, *Rukšāns & Zubov* s.n. (holotype: GB!).

Bulb: slightly elongated to ovoid, up to 20 mm in diameter and 25 mm long.

Tunic: membranous, light brown, adaxially all over densely covered with woolly hairs.

Leaves: 2, opposite, recumbent, leaf base below ground, recurved, slightly twisted, channelled, glaucous green stained purplish at glabrous margins and abaxial side, up to 10(-13) mm wide and 7-9 cm long, overtopping the flowers.

Flowers: actinomorphic, 1 (rarely 2), sweetly fragrant, carried on 4-7(-10) cm long glabrous purplish stem.

Perianth segments: 6, in two trimerous whorls; *outer perianth segments* narrowly lanceolate to lanceolate, up to 38(-40) mm long and 7-8 mm wide, abaxially dull lilac with greenish midrib, rarely light pinkish, at base light greyish yellow, adaxially white with small slightly greenish yellow, triangular basal blotch; *inner perianth segments* much wider, broadly lanceolate with pointed apex, slightly shorter than outer ones, 36-37 mm long, but much wider than outer ones, up to 18 mm wide, abaxially soft white with thin greenish midrib and yellow base from translucent inner basal blotch, adaxially soft white with small soft yellow basal blotch (~1/5 segment length), widely triangular or rounded at the base; inner segments densely hairy at very base, higher – nude or less densely hairy along the margins up to 2/3 of basal blotch length.

Androecium: stamens 6, in two trimerous whorls, diplostemonous; filaments linear, pure yellow to yellow, gradually shaded orange to the top direction, 7-9 mm long, densely hairy at very base but higher nude, rarely sparsely papillose or with few papillae higher; anthers linear, yellow, *c.* 5-7 mm long.

Gynoecium (ovary and receptacle): syncarpous, tricarpellate; ovary superior, light green, turning slightly greyish lilac at the top, sometimes dirty purplish, oblong cylindrical, ±triangular in cross section; placentation axile; style indistinct; stigma sessile, shortly trilobed, white to creamy with short hairs along upper margins of carpels.

Capsule: tricarpelate, obovoid to cylindrical, up to 25 mm long and 12 mm wide, loculicidal, greyish green to purplish, with pointed tips of carpels.

Seeds: brown, flattened with a narrow marginal wing, ±ovoid, *c.* 5 mm wide, in two rows per chamber (carpel), the seed coat made out of both integuments, but the testa is thin and the endosperm lacks starch, the embryo is small and visible.

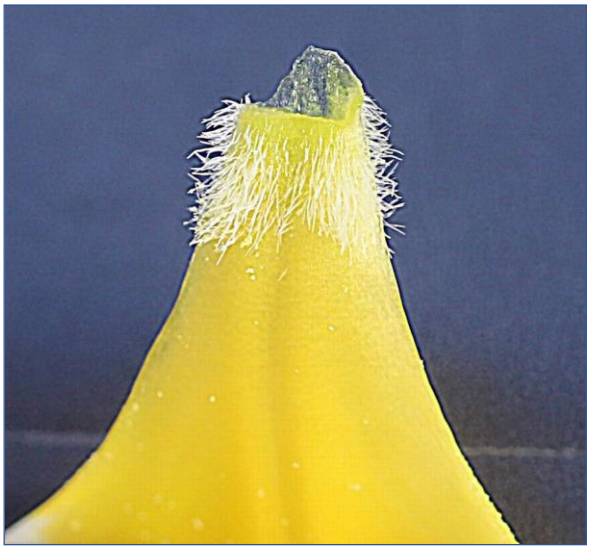
Tulipa humilis habitat in front of the pass, in background - *T. lorestanica* habitat at Gardaneh-ye Galeh Bādūsh Pass.

Tulipa lorestanica in its habitat at Gardaneh-ye Galeh Bādūsh Pass.

Tulipa lorestanica in its habitat at Gardaneh-ye Galeh Bādūsh Pass.

Flower details of *Tulipa lorestanica,* cultivated.

Tulipa lorestanica: inner segments base, cultivated.



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Tulipa lorestanica seed pods, cultivated.

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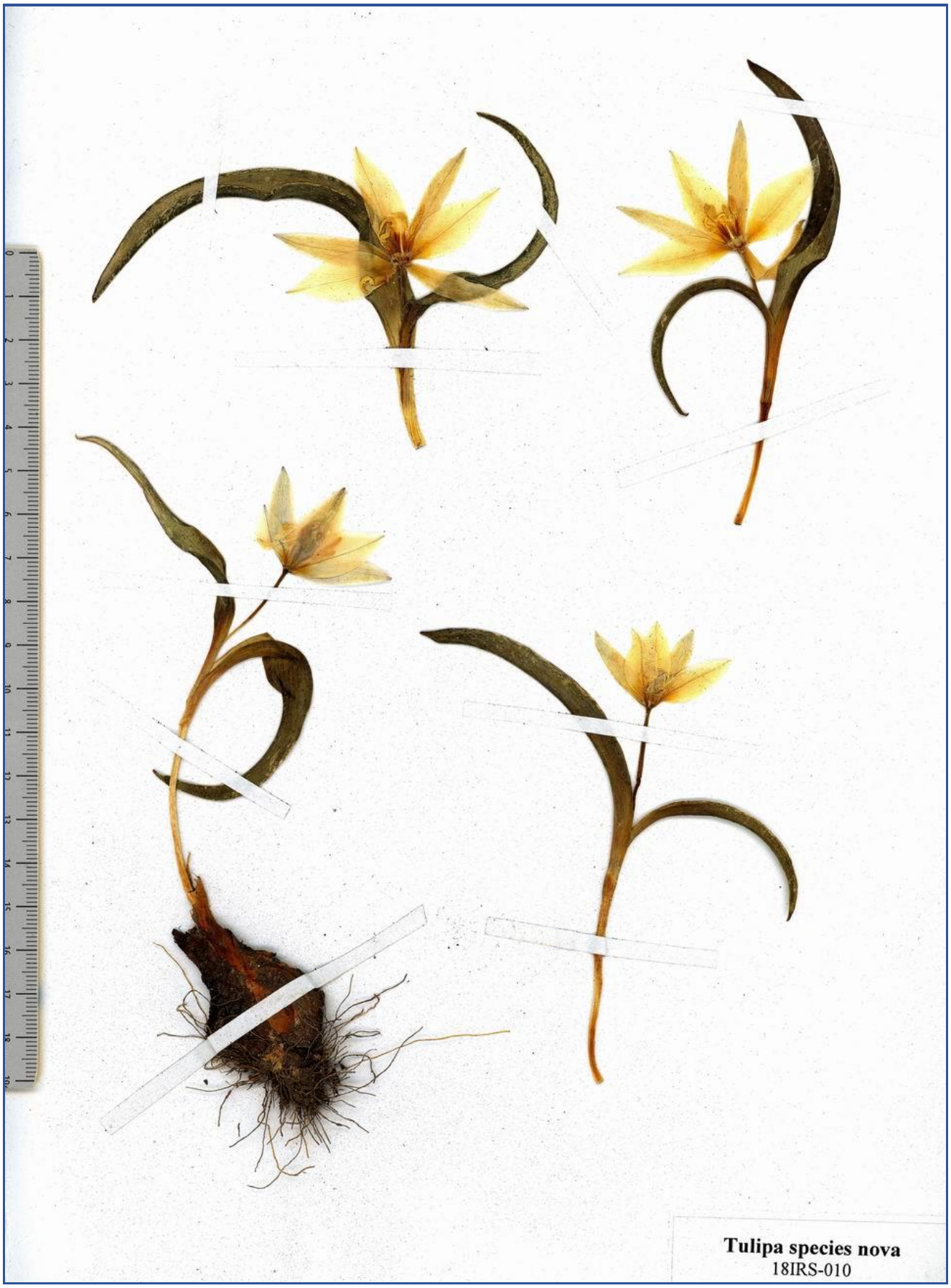
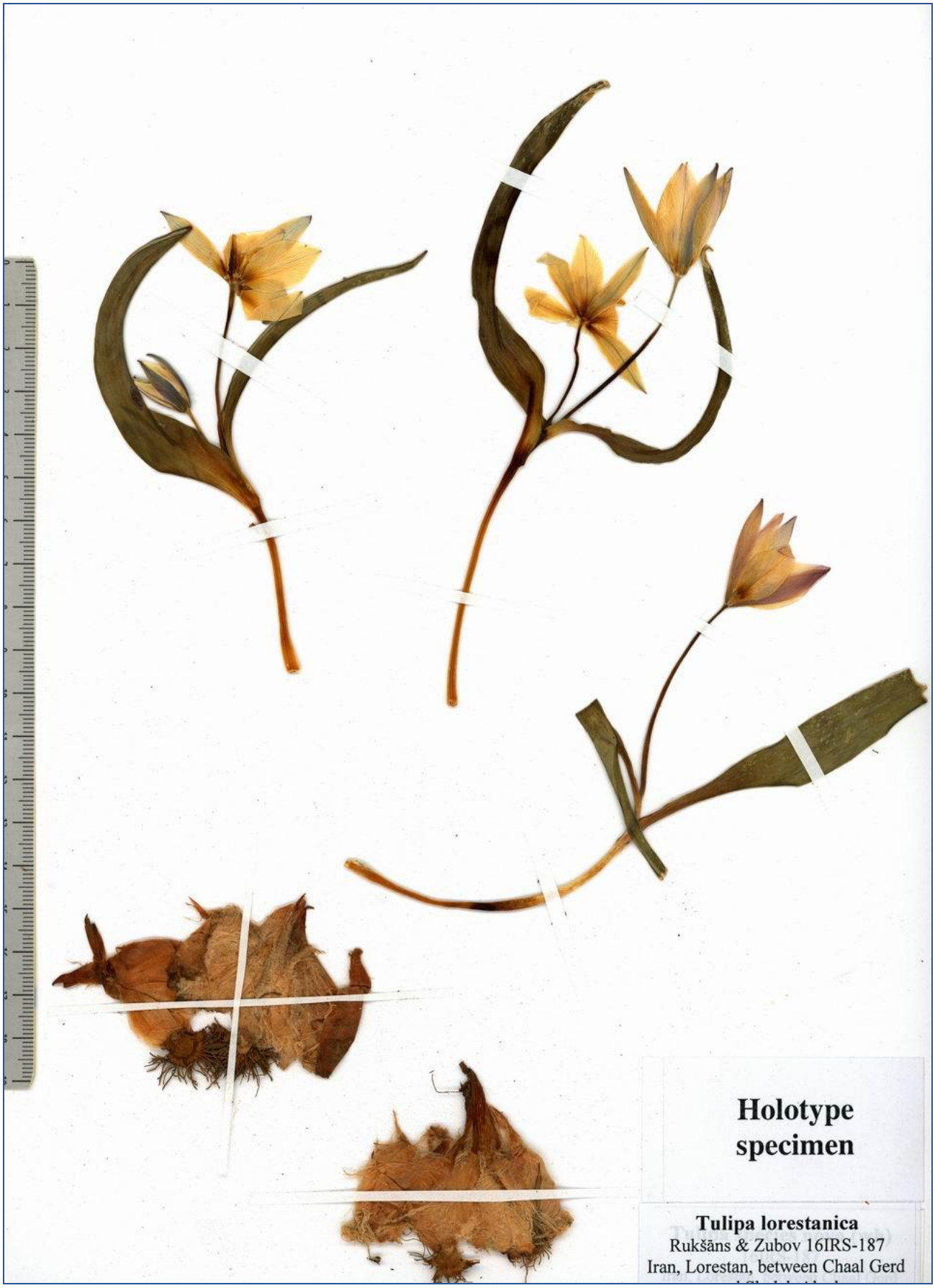


Herbarium sheet of *Tulipa lorestanica* deposited at GB.



Holotype sheet of *Tulipa lorestanica* deposited at GB.

Tulipa lorestanica bulb tunic, adaxial view (similar to the tulip accession 22IRS-104 and to another one from the Dehbid city vicinities).

Flower details and leaf shape of *T. biflora s.l.* from the eastern vicinity of Sanandaj city (22IRS-104).

Flower details and leaf shape of *T. biflora s.l.* from the northeast of Tabriz city (22IRS-033).

Tulipa biflora s.l. in the wild: the eastern vicinity of Sanandaj city (22IRS-104)

Tulipa biflora s.l. in the wild: the Dehbid city vicinities (photo – S. Alipour)

Tulipa lorestanica in its habitat at Gardaneh-ye Galeh Bādūsh Pass

RECOGNITION. Morphologically similar to *T. biflora s.s.* (*ex l.c.* – Volgograd vic.), but differs by having mainly 1 flower, 5-10 cm plant height, all over greatly woolly bulb tunic adaxially, linear oblong-rectangular anthers 5 mm long, and alpine habitat (*vs* having 2(-3) flowers, 15-22 cm plant height, sub-globous to ovoid anthers 3-4 mm long, and steppe lowland habitat for *T. biflora s.s.*). Morphologically similar to *T. kolbintsevii*, but differs by having 5-10 cm plant height, all over greatly woolly bulb tunic adaxially, prolonged bulb tunic neck absent, and alpine habitat (*vs* 14-17 cm plant height, glabrous, at the neck with some hairs bulb tunic adaxially, prolonged bulb tunic neck, and semi-desert valley habitat for *T. kolbintsevii*).

Distribution. Zagros Mountains range: W Iran; at present known only from its type locality (Lorestan Province). Map 3.

Specimens examined. Iran, Lorestan Province, Zagros Mountains, Gardaneh-ye Galeh Bādūsh Pass by Shool-Abad road, between Chaal Gerd and Khorramabad, on limestone screes between stone-chips; *c.* 2900-3000 m elevation, fl. 29 Apr. 2016, 16IRS-187, *Rukšāns & Zubov* s.n. (holotype: GB!). The exact locality of *T. lorestanica* has not been documented here for fear of unlawful plant collecting.

Habitat. Described from the high mountain pass, growing on south-western slopes, almost in nude limestone screes over underlying calcareous lithosols (brown soils) [12] together with *Allium haemanthoides* Boiss. & Reut. ex Regel and *cfr. Veronica hispidula* Boiss. at 2900-3000 m elevation. Mesophyte.

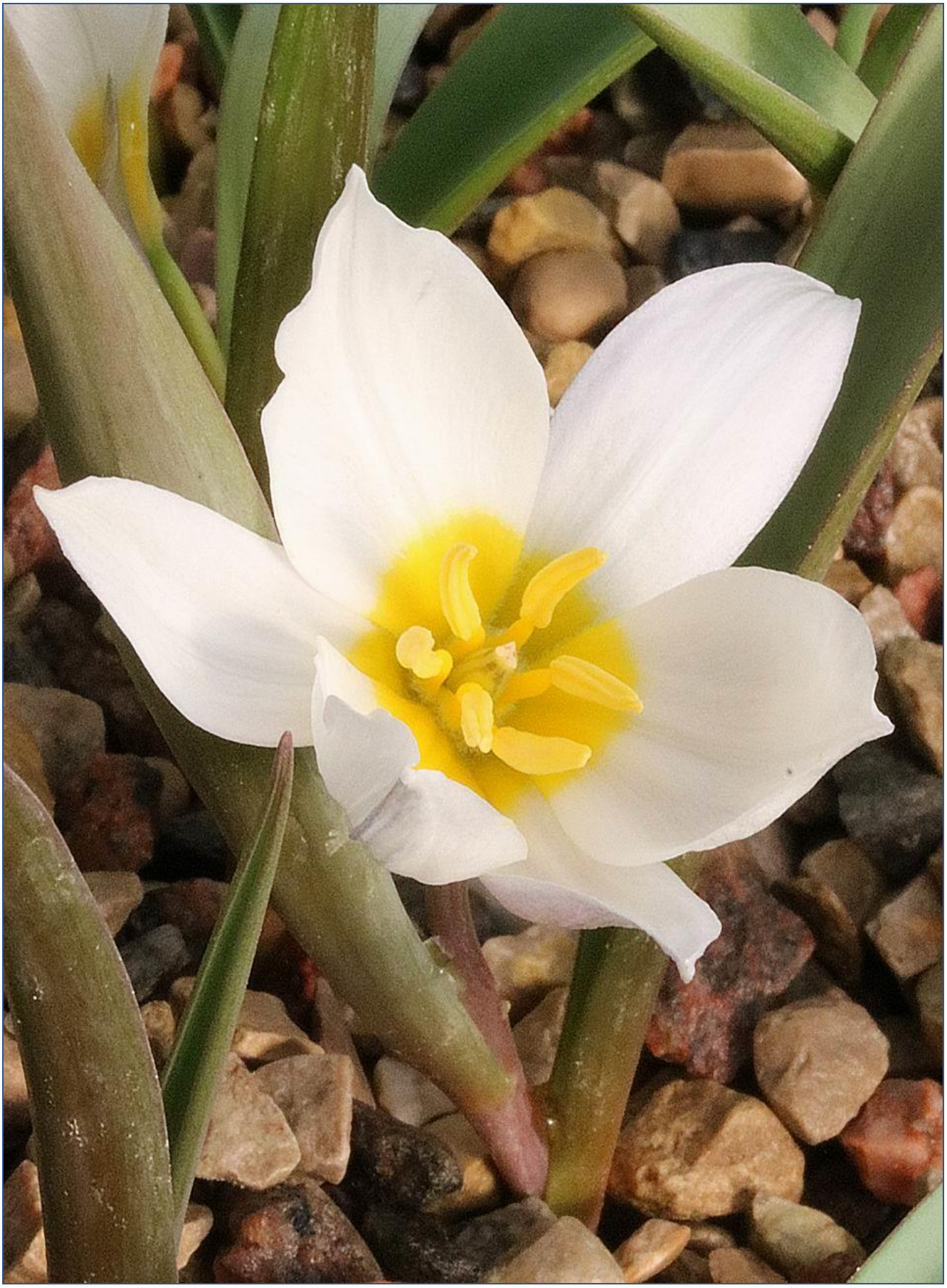
Conservation status. The preliminary conservation status of *T. lorestanica* was not assessed due to the insufficient data, but it could be informally evaluated between Vulnerable and Endangered [22] by known number of its locations in the wild. Map 3.

Phenology. Flowering: April – May in the wild; fruiting: not seen in the wild, presumably in June.

Etymology. Named after Lorestan Province in W Iran where it was discovered by us in April 2016.

Cultivation. *Tulipa lorestanica* is easy to grow applying the same agricultural practice as for most of other tulip species: we plant it at the end of September and give initially plenty of water to ensure good rooting. Cultivated plants, grown by J. Rukšāns in large unheated polytunnel, bloom in March.

Tulipa lorestanica in cultivation



Tulipa lorestanica in cultivation

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Allium haemanthoides growing in the same habitat with *Tulipa lorestanica* at Gardaneh-ye Galeh Bādūsh Pass.

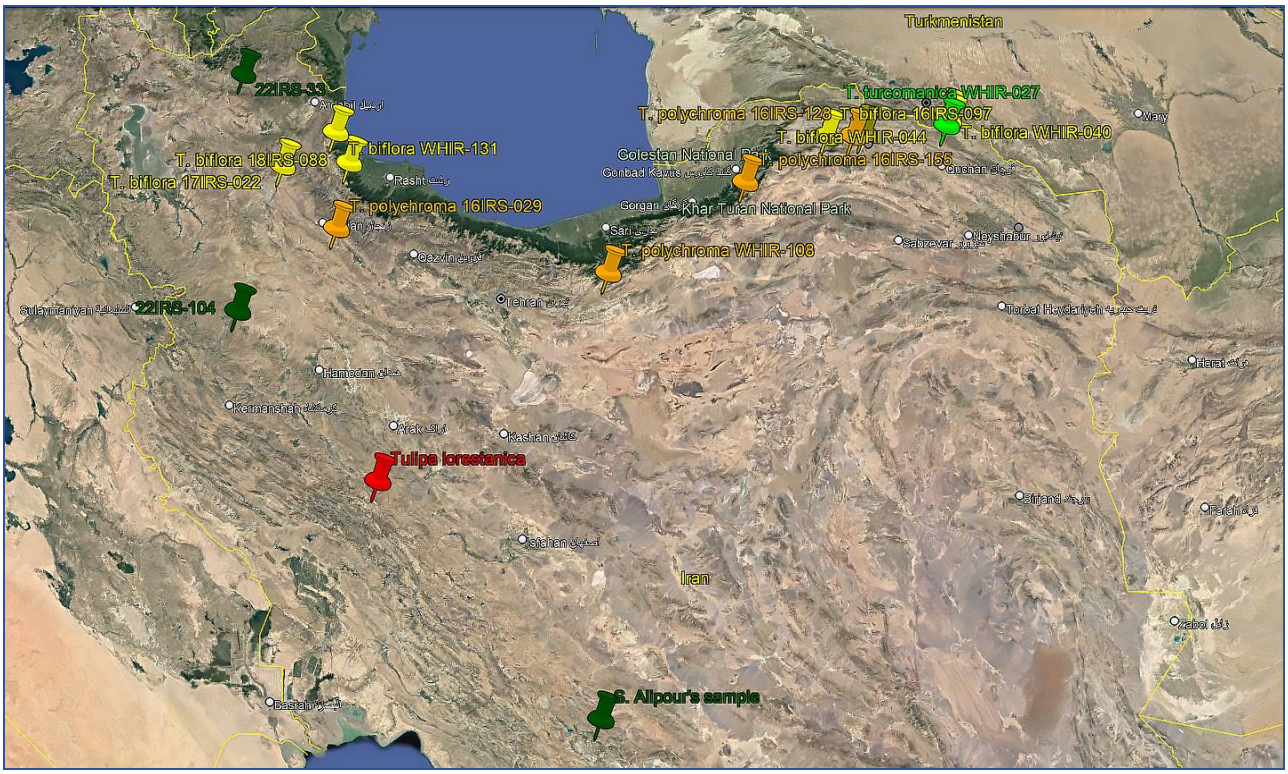
Tulipa humilis growing in the wild. (photo – V. Jošt)

Tulipa humilis grows on opposite side of the road to *Fritillaria imperialis*, at Gardaneh-ye Galeh Bādūsh Pass.

Tulipa humilis 16IRS-188 growing in cultivation.

Fritillaria imperialis growing on the opposite side of the road from *Tulipa humilis* at Gardaneh-ye Galeh Bādūsh Pass.

 Charity registered in Scotland SC000942 ISSN 2053-7557

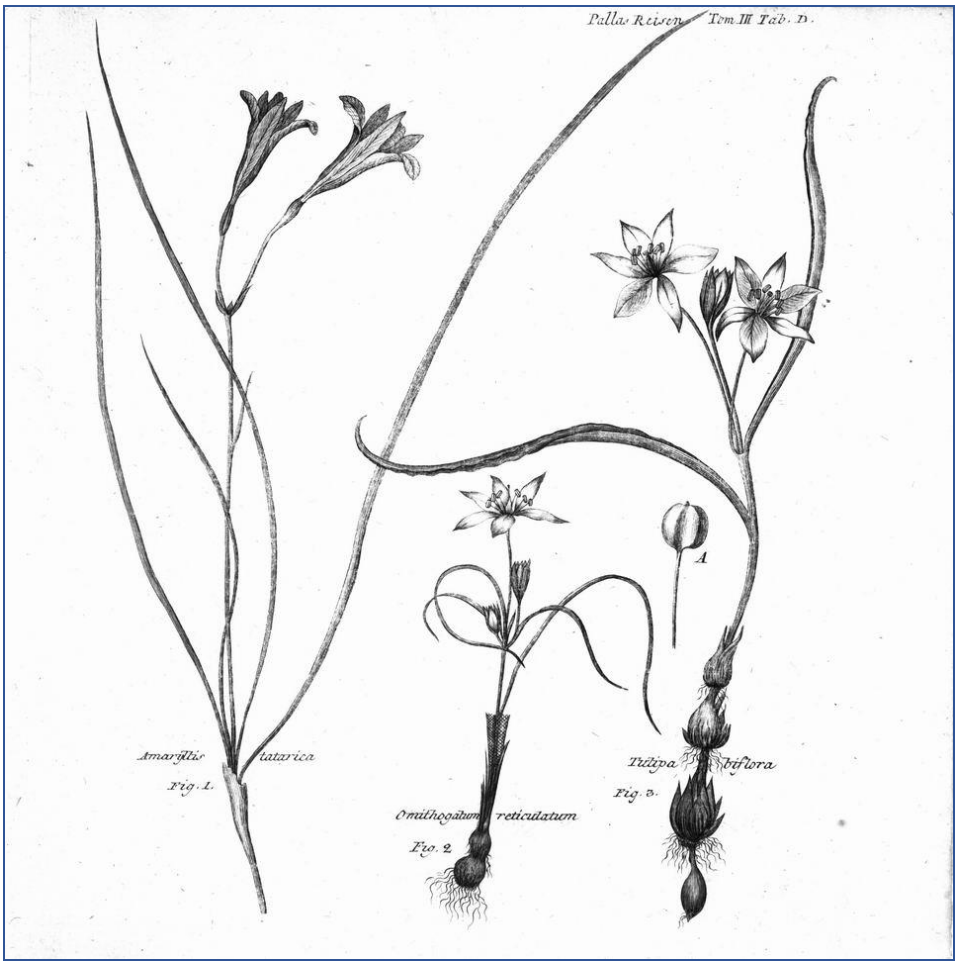


Map 3 – Localities in Iran where the *Eriostemones* tulips were observed: red mark - *Tulipa lorestanica* type locality, light green mark – *T. turcomanica*, brown marks – *T. polychroma*, dark green marks – newly discovered localities (April 2022) of *T. biflora cfr.*, and yellow marks – earlier known localities of *T. biflora cfr.*

Discussion

It is essentially important to give the correct data about distribution area of the newly published taxa. Just approximately given general localities, for example, *"Caucasus", "Anatolia"*, etc., do not allow later researchers to compare plants from other localities in the same region. Modern technologies allow us to determine the point, where type sample was gathered, very precisely, with an accuracy of few metres. The geographical information and provenance of the species samples is very important, because some of them are rare and endangered and may have restricted distribution areas. To save the newly described populations from being destroyed by "plant hunters", the exactly defined localities (their coordinates) should be avoided being free in an open access. But at the same time, such an approach can be elevated into the absurd level, as, for example, in the case of published taxon of *Crocus albocoronatus* (Kernd.) Kernd., Pasche & Harpke, given as growing simply in *"Central Taurus"* [23]. Only twenty-eight years later did Turkish botanists succeed in finding where exactly this species is growing wild, and it was not Central Taurus. A. Çiftçi et al. [10] wrote on this matter: *"In this case, a contradiction arises: "How do we protect an organism that we do not know and whose location we do not know?"*.

Insufficient information about localities, from where species was described, is useless for further researchers. It can lead only to the false results and subsequent misunderstanding. To avoid such situations some correct locality's data should be given. In our opinion the sufficient level of accuracy could be reached by giving in publication the degrees and minutes for GPS coordinates of the new taxon's type locality, and more exact data should be attached to the herbarium type sheets with no open access, but these detailed coordinates will be quite efficient to other scientists. It is the reason why in scans of the herbarium type sheets here, there are hidden coordinates details on labels.



Pallas' line drawing of *Tulipa biflora* from [26].

Again, returning to the key subject of our studies, it should be noted that *Tulipa* species from sect. *Biflores* are morphologically quite similar. Especially variable is type species – *Tulipa biflora* Pall. It was described by German scientist-encyclopaedist, naturalist and traveller in the Russian service – Peter Simon Pallas, from the Caspian steppes of Russian Empire during his physical academic expedition (1768-1774), organized by order of Empress Regnant of Russia, Catherine the Great. The taxon was published in Pallas' three volumes edition of *"Journeys through different provinces of the Russian Empire in 1768-1773"* [26]. In

his work, the author compares his species with *T. sylvestris*, indicating that it grows in desert places, mostly clayey, and even on salt marshes, but never in a wet or sandy place, where, however, *T. sylvestris* of varying size grows. According to the Conspectus of the Caucasus Flora [15, 30], *T. biflora* was described by Pallas from the Lower Volga region, in vicinities of Tsaritsyn town (now Volgograd city), Russia [9, 13, 15, 30]. It is known, that in September 1773 Pallas' expedition stopped in Tsaritsyn, where he remained until the next spring [26]. In general, the distribution area for *T. biflora* is mentioned as a huge territory beginning from Balkans in the west and ending in China in the east [8, 9], but in southern direction it even reaches E Egypt.

Syntype (BM 001066429) of *Tulipa biflora* originally made by Pallas; note the leaf length and shape of seed pods.

Travelling through many countries, where *T. biflora* is mentioned as growing, we observed a lot of morphologically very different populations growing in distinct ecological conditions, but in local floras they all are named just as *T. biflora*. Usually, seeing in the wild *Eriostemones* tulips with 1-3 flowers on stem and white flowers with yellow throat, it gets a label "*T. biflora*". Habitats where it grows are differently characterised in different publications, e.g., dry slopes, screes, deserts, salt marsh, steppes, solonchaks, clay, etc. Though Sir Alfred Daniel Hall did call it "an uncertain species" [19]. The presence of different species under common name of *T. biflora* was confirmed later by Zonneveld research [37], which showed the different nuclear genome size for various accessions labelled as *T. biflora* or hidden under some of its synonym names. So, undoubtedly under this name several different species are hidden, but how to separate them from true *T. biflora fide* Pallas? To distinguish and describe new taxa found in the *T. biflora* distribution region, a comparison with its type became necessary. At present the syntypes of *T. biflora* were deposited at BM & M herbariums and derived from Pallas' herbarium without a locality indication, although it is already known that all Pallas' *T. biflora* gatherings were made around Volgograd city in Lower Volga (Nizhneye Povolzhye) region, SW Russia. In 2013 the lectotype of *T. biflora* was designated by M. Christenhusz et al. [9] as: "Russia. Habitat ad Wolgam locis desertis maxime argillosis, "Deserta Caspica", *Fischer s.n.* (B-W-06559-010!)"; syntypes are present in BM (000528948!) and M. Considering the number of taxa that are synonymous with Pallasian *T. biflora* in the understanding of different authors [9, 13, 29, 37], this species can certainly be considered as a complex of species – species aggregate (*in taxonomy*, - a grouping of closely-related species that are treated like a single species for practical purposes):

***Tulipa biflora* (Pall.) agg. Zubov & Rukšāns**, with its multiple component *segregates*, or *microspecies*, such as:

T. biflora Pall. *sensu stricto*, ex SW Russia & Kazakhstan

T. sogdiana Bunge, ex Uzbekistan, Turkmenistan, Kyrgyzstan & Kazakhstan

T. buhseana Boiss., ex Uzbekistan & Turkmenistan

T. crispatula Boiss. & Buhse, ex Iran

T. polychroma Stapf, ex Iran, Azerbaijan & Afghanistan

T. androssowii Litv., ex Turkmenistan

T. koktebelica Junge, ex Crimea, Ukraine

T. turcomanica B. Fedtsch., ex Turkmenistan & Iran

T. humilis var. *ornata* Bornm. & Gauba, ex Iran

T. halophila Bornm. & Gauba, ex Iran

T. mariannae Lindtner, ex North Macedonia

T. binutans Vved. ex Kyrgyzstan & Kazakhstan

T. prolongata Vved., ex Tajikistan

T. kolbintsevii Zonn., ex E Kazakhstan

T. salsola Rukšāns & Zubov, ex E Kazakhstan

T. lorestanica Rukšāns & Zubov, ex W Iran

Tulipa biflora s.s. in the wild, near *locus classicus*: Volgograd city vicinities

(photo – E. Komarov [30])

Tulipa biflora s.s. in the wild, near *locus classicus*: Volgograd city vicinities

(photo – M. Kucherov [30])

Tulipa koktebelica in the wild, near *locus classicus*: Echki-Dag ridge, E Crimea

(photo – P. Yevseyenkov [30])

Tulipa halophila type deposited at BGBM.

However, it is necessary to clearly distinguish here between these two species definitions in the framework of our paper: *"taxonomic species"*, as a taxonomy definition, and *"microspecies"*, as a microevolutionary definition for segregates of a species complex, e.g., species aggregate in our case [17].

Therefore, we publish here two new species related to, or may be regarded by some botanists as conspecific to *T. biflora,* but in our opinion certainly deserving proper names and for sure they can be boldly called components-microspecies within *T. biflora* agg. Both are allopatric and very distinct by morphology, phenology, habitat, and distribution areas.

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First of all, we must express our thanks to Vladimir Kolbintsev (Kazakhstan), who guided us through Kazakhstan, where many interesting tulip samples (and many other geophytes) were seen. We must thank to our travel partners of this 2012 trip lead by Robert Wallis (UK) as well. Of course, without our travel partners of the 2016 Iranian trip organized by Jill White (UK) and 2018 trip organized by Alice Munsey (UK), who both invited us to take part in those expeditions, we could never have found so many interesting plants, even some new to science. We can't forget Sholeh Jalili Khiabani, our Iranian guide, who took care for everything to make our trips successful. And we are especially thankful to our families for the hard work at our gardens during our absence, because of the field studies *in situ*.

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Tulipa polychroma fide auct. in the wild, Golestan Province, NE Iran.

Supplement 1

KEY TO THE IDENTIFICATION OF CENTRAL ASIAN SUBGEN. *ERIOSTEMONES* TULIPS (= A.I. VVEDENSKY, 1971)

(modified by authors: in bold - species grown in authors' collections; not included *T. polychroma, T. sogdiana* & *T. talijevii* due to lack in the original key, although known in 1971; included *T. jacquesii* & *T. kolbintsevii* published much later 1971)

1 Leaf usually solitary with longitudinal crests on upper side ……..…….. ***T. regelii***

1 Leaves at least two, without longitudinal crests

2 Bulb covering sheets nude or only at very top with few adpressed hairs

3 Leaves 3-7, closely spaced ..…….……..……. ***T. tarda***

3 Leaves usually 2, distanced on stem

4 Bulb covering sheets thin, papery…….……..... ***T. dasystemon***

4 Bulb covering sheets thicker, leathery …….……..... ***T. neustruevae***

2 Bulb covering sheet inside throughout or only at top densely hairy or wholly

5 Anther tips rounded, without point

6 Flowers yellow, outer on outside often violet shade ……..***T. biebersteiniana***

6 Flower segments white, at base yellow, outer segments outside lilac shaded…….....…….. ***T. patens***

5 Anther tips shortly pointed

7 Bulb covering sheets inside at top densely haired, hairs addpresed

8 Bulb tunics thinly leathery, style comparatively long, ~ ½ of ovary length ……..... *T. dasystemonoides*

8 Bulb tunics leathery, style shorter

9 Leaves distinctly distanced, usually ends below flower …..…. ***T. buhseana***

9 Leaves less distanced, usually overtop flower……..... ***T. turkestanica***

7 Bulb covering sheets inside throughout or only at top wholly

10 Bulb covering sheets papery or almost papery

11 Leaves distanced, anthers 2-3 mm long …….....…***T. biflora***

11 Leaves almost opposite, anthers 4-6 mm long

12 Style elongated, very prominent…….…….. ***T. orithyioides***

12 Style very short…….……..……***T. subbiflora***

10 Bulb covering sheets leathery

13 Bulb covering sheets prolongated, even up to soil surface

14 Lower leaf ovate 30+ mm wide, flowers 1-4 …… *T. jacquesii*

14 Leaves linear, lower one up to 10 mm wide

15 Leaf margin straight ……..…. ***T. kolbintsevii***

15 Leaf margin undulate ……..…. *T. prolongata*

13 Bulb covering sheets not prolongated

16 Flowers usually one, rarely 2-3…… *T. turcomanica*

16 Flowers usually 2-8, rarely 1

17 Flower buds and flowers upturned ……..…..... ***T. orthopoda***

17 Flower buds and flowers or only buds down turned

18 Flowers after flowering upturned …….... ***T. bifloriformis***

18 Flower buds and flowers after blooming down turned ……..…… ***T. binutans***

Tulipa polychroma fide auct. in the wild, Golestan Province, NE Iran.

Tulipa polychroma fide auct. in the wild, Golestan Province, NE Iran.

Tulipa polychroma fide auct. in the wild, Golestan Province, NE Iran.

Supplement 2

KEY TO THE IDENTIFICATION OF SUBGEN. *ERIOSTEMONES* TULIPS FROM SECT. *BIFLORES* WITH WHITE FLOWERS (= Z.M. SILINA, 1977)

(modified by authors: in bold - species grown in authors' collections; not included *T. prolongata* due to lack in the original key, although already taxon published in 1977; included *T. jacquesii* & *T. kolbintsevii* published much later 1977)

1 Leaf usually solitary with longitudinal crests on upper side, flowers 1(2),
bulb tunics without prominent neck …… …. ***T. regelii***

1 Leaves linear, 2 or more, without crests

2 Bulb tunics with more or less prolonged and prominent neck

3 Leaves 2, ovate, leaf crests only in wild, not on cultivated plants,
flowers 1-4, bulb tunics with long and prominent neck **……** *T. jacquesii*

3 Leaves 2, linear, flowers one, bulb tunics up to 5 cm long …….. ***T. kolbintsevii***

2 Bulb tunics without prolonged neck

4 Leaves almost opposite

5 Style prolonged, stigma in distance from ovary

6 Bulb tunics leathery, inside nude, flowers 1-8(20). anthers shorter than filaments ……..…….. ***T. tarda***

6 Bulb tunics papery, inside finely hairy, flowers 1-2, anthers of same length or longer than filaments ……..……..... ***T. orithyioides***

5 style very short or practically absent, bulb tunics leathery, inside densely hairy, flowers 1-2(3) on short stem ……..…..…….. ***T. orthopoda***

4 Leaves distanced, style very short or practically absent, tunics inside hairy

7 Bulb tunics papery, inside throughout densely hairy, stem and pedicel nude, flowers 1-2(6), filaments thin, twice as long as anthers, anthers with shortly pointed tips ……..……..…….. ***T. biflora***

7 Bulb tunics leathery

8 Stem in upper part and pedicel pubescent

9 Bulb tunics throughout densely hairy

10 Bulb tunics densely woolly, hairs tangled, flowers (1)2-5(11), anthers mostly yellow with shortly pointed black tips ……***T. bifloriformis***

10 Bulb tunics inside covered with long, adpressed, waved but not tangled hairs, flowers 1-2-3 ……..…… ***T. talijevii***

9 Bulb tunics hairy only at top or at base

11 Bulb tunics hairy at top and minutely at base with coarse, adpressed hairs, bottom leaf sickle-shaped, flower buds and flowers after blooming down turned ……..……..……..…… ***T. binutans***

11 Bulb tunics wholly only at top, bottom leaf lies on ground, buds not down turned ……..……..….. ***T. turkestanica***

8 Stem and pedicel nude

12 Leaves up-turned or sickle-shaped, anthers 3x shorter than filaments ……..……..……..…….. ***T. polychroma***

12 Leaves ends below flower, distinctly rejected, up to 90 degrees anthers slightly or 2-2.5 x shorter than filaments

13 Bulb tunics throughout densely hairy, flowers 1-3, filaments in upper part orange, anthers yellow with black tips, 2-2.5x shorter than filaments, bottom leaf branch out 2 cm over soil…….. *T. turcomanica*

13 Bulb tunics at top finely wholly, anthers only slightly shorter than filaments, bottom leaf branch out 3-7 cm over soil……...***T. buhseana***

Hunting for the jewel of Tibet: *Saxifraga ludlowii* H.Sm.

By Vojtěch Holubec. Photos by Vojtěch Holubec unless stated otherwise.

In the Himalayas and China, there is a huge wealth of *Saxifraga Kabschia* section species, but only a small part of them have been imported into the culture. Most of them have been successfully described and rest in mostly colonial herbaria. Many species occur in remote locations in Tibet, where, apart from the old expeditionary botanists, none of the gardeners have yet strayed.

One such forgotten species was Ludlow's Saxifrage. This was collected by Ludlow's expedition in 1947 and subsequently described by Harry Smith in 1958. Smith highlighted its aesthetic merits: "with solitary pink flowers, bigger than any other *Kabschia*." However, he also mentioned the remoteness of the localities: "The following three species (*S. ludlowii, S. lowndesii* and *S. flavida*) occupy quite isolated positions without traceable connections to other species (Smith, 1958)". But we refuted this, because the species of stonebreakers often meet.

Saxifraga ludlowii

As far as I know, the first photograph of this beautiful saxifrage in full bloom was taken by the botanist and traveller Roman Businský from the pass at an altitude of 5000 m, from eastern Tibet. It was that image which inspired Czech rock gardeners to subdue this species in culture.

In 2005, when we were preparing a list of species of interest for our second trip to Tibet, I downloaded the descriptions and locations of the

saxifrages that we might meet there, and especially *Saxifraga ludlowii* was in our search. Our expedition was planned from the city of Chengdu in Sichuan to Tibet, through Markam to Rawu (also known as Rawok). While our social contacts officer Petr Antonín asked the Chinese at a street teahouse how best to get to Rawu, I tried to buy a permit from travel agencies. Petr was successful. He found a local native who promised excellent transportation for a reasonable amount of yuan. However, after two days of negotiations, when we were already losing hope, the new guide, ("Call me John") said he had secured seats on the bus for us and that he will go with us. Anyway, it was our last chance. For two days, the sleeping bus chattered on the rocky road. Everyone was broken and uncomfortable by driving, only Josef Jurášek did not complain, because he was the only one who did not have a neighbour's legs behind his neck and the short seat suited him perfectly. Zdeněk Obrdlík was also satisfied because he wasted time flirting with Tibetan girls. I came off worst. As I leaned in from the upper bunk in front of the metal handrail to get a better view of the window, the bus was crossing a large boulder on the road at that moment, and my rib, resting on the railing, crunched audibly. From then on, my every move, cough and laughter became my nightmare. But the desire for future exploration was a healing band-aid.

Rawu.

David Holubec enjoying lunch in the spectacular surroundings.

Rawu.

We finally arrived in the coveted Rawu, a forgotten corner of SE Tibet. But the next day we needed to go back to the pass. Transport was not available, so after an hour of walking uphill we stopped at least a small tractor. But he drove us only about 2 km and then the poor vehicle's engine conked out!

Obrdlík, Antonín, Jurášek, and David Holubec on the back of the small tractor.

We went to a beautiful valley at an altitude of about 3900 m. We admired the flowering gentian *Gentiana szechenyi, G. veitchiorum, G.lawrencei* var. *farreri,* piercing a cushion of plants with an inexhaustible number of alpines (*Androsace tapete, Cyananthus microphyllus, C. flavus, Leontopodium nanum* and others). *G. veitchiorum* was in a range of colours from the typical deep blue to purple, porcelain blue, grey and white. But we were attracted by a snow-capped, majestic mountain, about 4500 m high and falling sharply into a small lake in a side cold valley. Josef and my son David and I went to this promising place. On the way, we ate the refreshing ripe fruits of creeping sea buckthorn (*Hipophae tibetica*) on the riverbank.

Gentiana veitchiorum.

Gentiana lawrencei.

The high glacial moraine boasted the fragrant scree species *Eriophyton wallichii, Phyllophyton complanatum, Saussurea gnaphalodes* and *Erigeron* sp. Beneath large boulders in granite sand with limestone, we registered what we were seeing all the time. The first non-flowering saxifrage - finally *Saxifraga ludlowii* !

Finally, *Saxifraga ludlowii.*

In the wet limestone rock falling into the lake next to the edge of the glacier, there was a species of *Porphyrion* section, probably *S. decussata,* then *S. decora, S. chionophila* and another species unknown to us. Our efforts had finally been crowned with success. We managed to collect a few seeds, which we then distributed to the world. What a joy we had when, after about three years, Martin Hajman, a Czech gardener in the Arctic Botanical Garden in Tromsø, wrote to us that a pink saxifrage had blossomed in the rock. After searching the name tags, the source read *S. ludlowii*, VH 2005. Next to it, another species from the same locality, *S. decora*, bloomed. Probably the first introduction of *S. ludlowii* into culture.

Gentiana veitchiorum at Rawu 2005.

Gentiana veitchiorum at Rawu 2010.

We gradually returned from Rawu to Markam. Along the way, we spent the night and botanized on all the passes over 4000 m, which had an incredible beauty and was a unique opportunity to explore the local alpine zone. In the meantime, our guide John was always looking for transportation for our five travellers the next day. He came unhappily every morning with the words that he had to leave us, because it was a poor business for him, and he gradually bid for another 1,000 yuan a day over the agreed price. Our wallets were thinning suspiciously. We crossed the border back from Tibet to Sichuan.

Upon our return, we reported on our findings at rock gardening conferences, and many friends also arrived in Tibet and photographed the saxifrages in full bloom. We managed to return to Tibet only in 2010, and with a rented car from the travel agent. This time we were driven by a somewhat arrogant driver Bimbo and accompanied by a frightened guide Jisha.

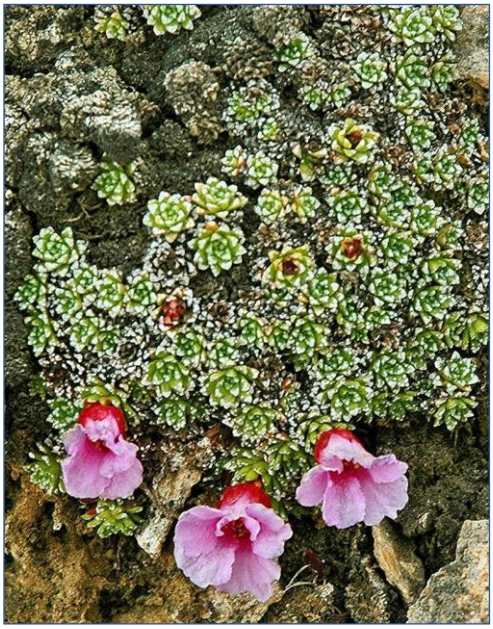
This time our route was reversed, from west to east. From Lhasa, Tibet, we advanced through magnificent passes at altitudes from 4 to 5,000 m until we reached Rawu. But even this time it wasn't just that. At the barrier in front of the village, we learned that we could not go further because we lacked a permit to Qamdo (Chamdo) province. The soldiers eventually let us spend the night in a hotel behind the military garrison, saying that we had a curfew, but fortunately they had no more interest in us. Jishi was afraid of trouble and lamented that we never leave the hotel. However, our desire for botanising was stronger than Mr. Jisha's fears, so Pavel Křivka and I went again to the valley with saxifrages. We wanted to explore other possible locations. This time we continued for about 10 km to the end of the valley, where the barrier of beautiful white towers towered. With all our might, we scrambled under the rock wall and found that the whites were not limestone. Disappointment ensued, however, we continued traversing the rubble along the rocks until we finally reached the limestone section. The flora was interesting here, but to our disappointment there were no saxifrages. So, in resignation, we dined on a bad bread with pieces of local garlic, *Allium farreri*, and descended from the rocks in disappointment. We no longer even hoped for success. But then our eyes focused on the foot of one wall. Huge buns were great in the wet rocks! "Eureka!" sounded through the ether. They were there! One bunch over 1 m long supported the terrace, smaller bunches filled wet joints. Our joy continued.

We took photos, picked up a few seeds and cuttings from various forms into the culture for the breeder Karel Lang, and returned with victory. We arrived in Rawu in a hurry around midnight, but with a feeling of sweet success from finding a new location.

Saxifraga ludlowii selection 2016.

Saxifraga ludlowii, Zayul, 2016.

We repeated the next trip to Tibet once again in 2016, again with Josef Jurášek, also with David Horák and Martin Hajman. We left Lhasa again planning a similar trip. In Rawu, the scene was repeated as in 2010, our guide did not have a permit to Rawu and to the north. Fortunately, we had in reserve another Harry Jans site in the direction of Zayul. So we went straight south. We



passed the limestone rock walls and it was clear to us that they must have saxes. In this locality, the plants were both at the wetter heels of the rocks and high in the drier pockets of the rocks. The plants were more variable in the shape of rosettes and encrustations on the leaves. We removed cuttings from different types of plants for cultivation. I was also happy to hand over a selected compact form with richly inlaid white rosettes to Karel Lang. I really appreciate that our best breeder managed to breed interesting new cultivars from the collected and selected forms. *Saxifraga ludlowii* thus ranked among our best introductions after finding *Saxifraga dinnikii and S. columnaris* in the Caucasus. Nothing wrong with that; red and pink saxifrages always lead the way!

Saxifraga ludlowii – near Rawu, Xizang (Tibet), China c.4800m.
Photos this page by Dieter Zschummel.

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Holotypus: Ludlow, Sheriff, Elliot, 22. 6. 1947, Kongbo, Pasum Chu, Ba La, 4350 m BM 13968.

Right: [Isotype - F. Ludlow, G. Sherriff & H. H. Elliot, #13968. Herbarium of the Arnold Arboretum (A)]

Saxifraga ‘Zdenek Zvolanek’ - is a charming break between the Iranian *Saxifraga ramsarica* and the rare Tibetan *Saxifraga ludlowii*, made and named by Karel Lang.

Saxifraga sp. - from seed named *S. chionophila*, 2008.
Photo Martin Hajman of Tromsø Botanic Garden.

 Charity registered in Scotland SC000942 ISSN 2053-7557

Saxifraga ludlowii (came with *S. chionophila* seed). Photos Martin Hajman.

Saxifraga ludlowii. Photo Martin Hajman.

 Charity registered in Scotland SC000942 ISSN 2053-7557

Cultivation of *Saxifraga ludlowii* by Ger van den Beuken

Saxifraga ludlowii, grown and photographed by Ger van den Beuken.

First, a few words about *S. ludlowii*. The plants I grow are seedlings from seeds collected by Harry Jans in S. E. Tibet. The plant's appearance is very similar to that of *S. lilacina,* with a clear difference in the flower. The cultivation has turned out to be quite simple and the plant feels most at home in a well drained neutral substrate.

S. ludlowii is a slow and extremely compact growing species suitable for alpine-house cultivation but also recommended outdoors on tufa with cover during winter. The propagation is initially done by seeds. From seedling to flowering plant took 4 years. The sowing medium consisted of a mixture of ordinary fine sowing soil with the addition of a large proportion of perlite. Of course, another drainage material would also suffice.

The time I used for sowing was in early December and exactly the same as for all other alpines I sow.

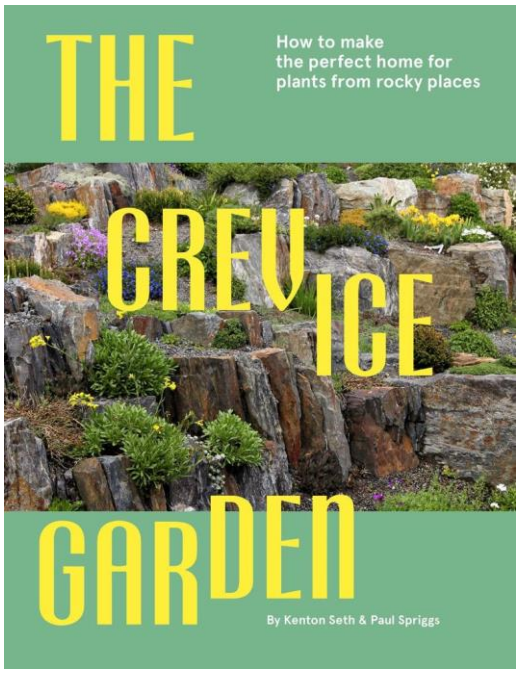
A cold period is an important asset to break dormancy. For sowing I use 9cm square plastic pots. Always put a layer of coarse gravel on the bottom of the pot to ensure good drainage. It is very important to cover the seeds with a very thin layer of fine gravel. Watering is always done from below to prevent the seeds from flushing together.The tiny seedlings appeared quite quickly in spring. Pricking out in a larger tray after a year until the small plants were manageable. A light solution of liquid fertiliser encourages growth. Let the plants grow on until they are well rooted, then transplant into pots or directly outdoors into tufa. So far I have not propagated any new plants from seed, because propagation from cuttings is much easier. Take small cuttings in the spring when the plants are in full growth. As a medium I use a mixture of 80 % pumice, perlite and coarse sand completed with a part of fine peat. The pots are placed in a closed propagator away from direct sunlight.After a period of some months, the cuttings are rooted sufficiently to be potted. In general, this species is easy to propagate and cultivate, which is important for the further spread of this great acquisition.

Ger introduced the cuttings he had received in 2008 from Harry Jans in early 2009 in the SRGC Forum.

This stunning photograph from Jozef Lemmens of a young *S. ludlowii* cutting was also shown in the SRGC Forum and shows very well the dark hairy calyx of this plant.

Many thanks to all the photographers for their help!

‘The Crevice Garden’ – review by J. Ian Young



The Crevice Garden ISBN: 9781739903909 by Kenton Seth and Paul Spriggs, subtitled “How to make a perfect home for plants from rocky places”, published April 2022 by Filbert Press, priced at £25.

Kenton J. Seth is a Colorado-based garden designer who works at home and abroad specializing in crevice gardens, drought-tolerant natives, and meadows **Paul Spriggs** is a professional gardener and landscaper who learned to build crevice gardens directly from one of its innovators, Zdeněk Zvolánek, of the Czech Republic who contributes the Foreword.

For some years since I first learned that KS and PS were working on a book on crevice gardens I have been looking forward with anticipation to its arrival. At this point I must declare my interest that both authors are friends of mine, so I know the reason we have had to wait has been because of the amount of research, fact finding and pictures the authors were accumulating. Gathering all that information involved visiting and photographing natural landscapes as well as examples of crevice gardens across the world especially Czechia - for completeness they also delved into history taking us back to the earliest mention of the crevice garden in 1870. All their work has resulted in a comprehensive exploration and explanation of the science, art and style of the crevice garden. The book describes how to build a crevice garden but equally important to me are the texts and illustrations explaining why crevices work for such a wide range of plants from the mountains, deserts and coastlines of the world.

The book guides the reader through the step by step process of the crevice garden from location, orientation, the amount of materials required, onto construction - explaining, through their understanding of soil science and micro environments, how such formations of closely placed rocks helps the resilience of plants enabling them to tolerate a wide range of gardens and climates.

Notwithstanding the vast hands-on experience of the authors, in the chapter on Case Studies, they have drawn together some actual examples illustrating crevice gardens in private and public gardens across a variety of climates which demonstrate crevices of all sizes from small containers though an array of sizes displaying a wide range of styles and rock types from natural stone to concrete including work done by other exponents, many form the Czech Republic, such as their mentor and teacher Zdeněk Zvolánek.

An illustrated A-Z recommending a range of 250 plants gives the reader suggestions appropriate for most garden climates from summer moist, through dry, to cacti and succulents suitable for deserts.

Once you have built your crevice the ‘living with a crevice garden’ chapter gives tips on long term care and maintenance covering topics such as labels, irrigation, fertilising, weeds and propagation.

Crevice gardens are very appropriate in our climate conscious world helping gardeners address environmental concerns, beyond conservation of rare plants, by re-using waste materials such as concrete, creating wildlife habitats and making permeable, plant-friendly structures which should have a place in even the smallest of gardens.

With the exception of the title and chapter pages every spread has photographs and /or detailed paintings by KS alongside the explanatory text. The reader could learn to build a crevice garden from the images alone but reading the very understandable text will explain the science and horticultural principles that make them successful.
As well as the authors I will congratulate the Designers, Studio Noel, and Publisher, Filbert Press, for delivering such an attractive well laid out illustrated book that inspires, guides and educates the reader in a logical way from the very question of what makes a crevice garden through all the practicalities of constructing, planting, then long term care of these fascinating creations.

As well as injecting the book with their own passion and international experience of building many crevice beds in private and public garden the authors ‘invite you to build upon and explore what has gone before’.
I recommend this book: it will act as a reference, a guide and an inspiration to anyone who wants to rock into the world of the crevice garden. J.I.Y