Taxonomy of two blue-flowered juno irises (*Iris* subgen. *Scorpiris*, Iridaceae) from the Western Tian-Shan

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Received 13 Apr. 2017, final version received 16 May 2017, accepted 2 Aug. 2017

Lazkov G.A. & Sennikov A.N. 2017: Taxonomy of two blue-flowered juno irises (*Iris* subgen. *Scorpiris*, Iridaceae) from the Western Tian-Shan. — *Ann. Bot. Fennici* 54: 297–305.

The taxonomic applications of two species names of *Iris* subgen. *Scorpiris*, *I. albomarginata* R.C. Foster and *I. willmottiana* Foster, are clarified. These species are confirmed to be taxonomically separate, and they are redescribed and mapped for the first time. Both species are endemic to the Western Tian-Shan. *Iris albomarginata* has evenly pale-blue flowers and occurs in the Ugam and Pskem Ranges (Uzbekistan, Kazakhstan), whereas *I. willmottiana* has blue flowers with white-blotched blades of the outer segments of the perianth and occurs in the Karatau and Boralday Ranges, and also in the northern part of the Talas Range (Kazakhstan, Kyrgyzstan). *Iris willmottiana* is reported as new to Kyrgyzstan. An identification key for blue-flowered juno irises of the Western Tian-Shan is provided.

Introduction

It has always been difficult to deal with the taxonomy of species of *Iris* (Iridaceae). Because of their high ornamental value, several species were described from cultivation before they became properly documented in the wild. This was the case with e.g. *I. graeberiana*, which was described from cultivation without provenance (Mathew 1997), then it was redescribed from the wild in Kyrgyzstan as *I. zenaidae* (Vvedensky 1971), and the cultivated plants were matched with the native ones only recently (Ikinci *et al.* 2011, Lazkov *et al.* 2014). Previously *I. graeberiana* (syn. *I. zenaidae*) was confused with another species, which was described from

Uzbekistan under the name *I. coerulea* nom. *illeg.* and then renamed *I. albomarginata* R.C. Foster (Vvedensky 1971).

Continuing a series of taxonomic corrections and revisions of the distribution data of juno irises (*I.* subgen. *Scorpiris*) in Kyrgyzstan (Lazkov *et al.* 2014, Lazkov & Sennikov 2015), we make further notes on the taxonomy of two blue-flowered juno irises commonly treated as a single species under the name *I. coerulea* or *I. albomarginata*. We also clarify the applications of the name *I. willmottiana* Foster, which were uncertain or conflicting during the 20th century. The diagnostic characters of these two species were confused and their precise distributions have never been circumscribed. In the pre-

sent paper we attempt at clarifying these long-standing confusions, providing a comprehensive review of the taxonomic literature, herbarium records and field observations of *I. albomarginata* and *I. willmottiana*.

Material and methods

The holdings of FRU, LE and TASH, which include the most extensive collections of vascular plants from Kyrgyzstan and Uzbekistan, were examined for the blue-flowered junco irises of the Western Tian-Shan. The relevant literature was screened for taxonomic, nomenclatural and distributional information. The online resources (www.plantarium.ru) were consulted for field photographs and further distributional information, especially from Kazakhstan.

New standardised descriptions were compiled on the basis of observations in nature, herbarium specimens and field photographs available at www.plantarium.ru. The species' distributions were mapped based on herbarium specimens and reliable field observations published in literature (Ivashchenko 2005, Rukšāns 2007, Ikinci *et al.* 2011) and at www.plantarium.ru.

Distribution maps were made using QGIS ver. 2.18.0 (<http://qgis.org/en/site/>), with the base map produced from open-access sources as follows: hill shading was created using R ver. 3.3.2 (R Core Team 2016), digital elevation model (DEM) was obtained using the R package *raster* from the hole-filled CGIAR-SRTM data (90 m resolution) (<http://srtm.csi.cgiar.org/>), and waterbody data of VMap0 was downloaded from GIS-LAB (<http://gis-lab.info/qa/vmap0-eng.html>).

References to the *International Code of Nomenclature for algae, fungi and plants* are provided according to McNeill *et al.* (2012). The circumscription of *Iris* follows Ikinci *et al.* (2011) and Wilson (2011).

Results

Iris albomarginata

Fedtschenko (1904) described his *Iris coerulea* as having lilac-blue flowers with obscure

longitudinal stripes on the falls (“*lamina [...] lilacino coerulea, [...] maculis longitudinalibus obscurioribus notata*”). He intentionally decided not to base his new species name on the earlier variety, *I. caucasica* var. *caerulea* Regel (cf. Fedtschenko & Fedtschenko 1905), and later treatments of this variety as the basionym of Fedtschenko's species name (e.g. Dykes 1913, Fedtschenko 1924, World Checklist of Selected Plant Families: http://apps.kew.org/wcsp/namedetail.do?name_id=323042) are erroneous.

The type locality of *I. coerulea* is along the Semizsaz-Say River, a left tributary in the upper reaches of the Pskem River, on the western side of the Pskem Range within present-day Uzbekistan. The locality was spelled “Sjemessas” in the protologue; because of that spelling, nobody has correctly deciphered this place name before.

Although the species was known to its author from observations on cultivated plants, its original locality was not well explored, and later interpretations of the species were made without taking into account living plants from the type locality (e.g. Vvedensky 1923). The distribution of *I. coerulea* was recircumscribed and was continuously expanding with the inclusion of the following territories: Ugam River (Vvedensky 1923; probably correct, specimens unknown), Jabagly-Su River (Vvedensky 1935; now *I. willmottiana*, see below), Karatau Mts. (Pavlov & Poliakov 1958; now *I. willmottiana*, see below), Fergana Range (Vvedensky 1935; later described as *I. zenaidae* = *I. graeberiana*: Vvedensky 1971). For unknown reasons the species was not included in *Flora of Uzbekistan* (Vvedensky 1941).

The broad circumscription of *I. coerulea* and the lack of knowledge of the original populations led to the appearance of strikingly incorrect features in its later descriptions, such as distinct yellow spots along the crest (Vvedensky 1935, Pavlov & Poliakov 1958, Ivashchenko 2005). It was not until Rukšāns (2007) discovered wild plants close to the type locality that the species became properly understood; according to those plants, the species should include populations with pale blue flowers, having unspotted falls with darker longitudinal stripes of blue. According to our observations, such plants are limited in their distribution to the mountains of Pskem and Ugam Ranges.

The nomenclatural history of the species was complicated by the fact that Fedtschenko (1904) selected the epithet which was already occupied in *Iris*. The correct replacement name, *I. albomarginata* (Foster 1936) passed unnoticed for some time, resulting in two later superfluous replacements: *Juno coerulea* Poljakov (Pavlov & Poliakov 1958) and *Iris fedtschenkoi* F.O. Khass. & Rakhimova (Khassanov & Rakhimova 2012).

So far, there is no correct description or distribution area of the species published in the taxonomic literature, although the species has been correctly interpreted in some phylogenetic works (Ikinci *et al.* 2011, Mavrodiev *et al.* 2014) but not in others (Guo & Wilson 2013). We contribute the present treatment as a remedy.

Iris albomarginata R.C. Foster

Contr. Gray Herb. 114: 42. 1936. — *Iris coerulea* B. Fedtsch., Bull. Herb. Boiss., sér. 2, 4: 917. 1904, *nom. illeg., non* Spach 1846. — *Juno coerulea* Poljakov in Pavlov, Fl. Kazakhst. 2: 250. 1958, *nom. illeg. superfl.* — *Juno albomarginata* (R.C. Foster) Rodionenko, Bot. Zhurn. (Moscow & Leningrad) 79(9): 105. 1994, *comb. inval.* (Art. 41.5). — *Iris fedtschenkoi* F.O. Khass. & Rakhimova, Stapfia 97: 178. 2012, *nom. illeg. superfl.* — TYPE: Uzbekistan. [Pskem Range:] Pskem River valley, “Sjemessas” [Semizsaz-Say], 9 August 1902, B. Fedtschenko (LE, barcode LE00050054!), lectotype designated by Boltenkov 2016: 227).

Juno capnoides auct.: Ivashchenko 2005: 176.

Bulbs 2–3 cm in diameter, 3–4 cm long, ovoid. Bulb tunics slightly extended, papery, brown, up to 6 cm. Roots not swollen. Scale leaves 2, membranous, clasping, brownish or pale brownish. Stem 15–25 cm above ground, internodes shortly visible in anthesis. Leaves 5–7, developed by anthesis, clasping, almost straight, broadly dilated at base, broadly attenuated at apex, lowermost ones 10–15 cm long, 1–4 cm wide, uppermost ones 5–10 cm long, 1–2 cm wide, pale-green above, glaucous-green below, with distinct white margins. Inflorescences with 1–5 flowers, rather lax. Bracts 5–7 cm long, 1–2.5 cm wide, lanceolate, pale-green, membranous at apex and along margins. Flowers 5–7 cm in diameter; flower tube 4–6 cm long, violet; falls 4–5 cm long, claw 2.5–3 cm long, winged, up to 2 cm wide, blue to lilac with thin darker stripes,

blade 1.2–1.5 cm long, 0.9–1.2 cm wide, ovate, not emarginate at apex, whitish with violet lines, unspotted; crest 0.7–1 cm long, dentate or shortly fimbriate, whitish; standards deflexed, 1.2–1.8 mm long, lanceolate or narrowly lanceolate, trilobate at apex, pale blue. Style branches 3.5–4.5 cm long, with lobes 1–1.2 cm long, 0.5 cm wide. Stamens with filaments 1.2–1.5 cm long, anthers 1.5–1.8 cm long. Pollen well-developed.

The name *Juno coerulea* Poljakov is illegitimate because of the existence of the earlier legitimate homotypic species name whose epithet is still available in *Juno*, *Iris albomarginata* R.C. Foster (Art. 52.1).

The name *Iris coerulea* B. Fedtsch. was published without any specimens cited but with a mention that the bulbs were collected in the wild on 9 Aug. 1902 and the plants flowered again in cultivation in May of 1904 (Fedtschenko 1904). In the absence of any specimen cited, the original material is those specimens or illustrations on which the validating description was based (Art. 9.3); however, Fedtschenko explicitly stated that he compiled the species description from living plants only. The species name has therefore no original material (Sennikov & Calonje 2016). Boltenkov (2016) designated a voucher collected by B. Fedtschenko with the bulbs and preserved at LE as the lectotype of the species name. Poor as a field-dried plant of juno can be, this specimen cannot be a lectotype according to Art. 9.3 but may serve as a neotype (Art. 9.7). However, under a revised definition of original material (McNeill *et al.* 2016) any specimen associated with the protologue may be treated as part of the original material, and the lectotype designation of Boltenkov may stand if the proposal of McNeill *et al.* will be approved at the Botanical Congress in 2017.

DISTRIBUTION AND HABITAT. Western Tian-Shan: Pskem and Ugam Ranges within Kazakhstan and Uzbekistan (Fig. 1). Stony slopes in the middle mountain belt, at elevations of 2300–3000 m. Flowering from April to the beginning of May.

SPECIMENS AND RECORDS. **Kazakhstan.** Ugam Range: Sairam-Su River basin, A. Ivashchenko (Ivashchenko 2005); Sazanata River, 28 April 2006 and 5 May 2011 Yu. Pirogov (Plantarium). — **Uzbekistan.** Pskem Range: Semizsaz-Say, 9 August 1902 B. Fedtschenko (LE!); Ixnachsay, 1998 J. Rukšāns (Rukšāns 2007, Ikinci *et al.* 2011).

Fig. 1. Verified distribution areas of *Iris albomarginata* (triangles) and *I. willmottiana* (dots).

CULTIVATION. *Iris albomarginata* was originally introduced in 1902 from its type locality to the private botanical garden in Olga Fedtschenko's manor Olgino, Moscow Region of Russia, which was a place famous for introduction of many central Asian plants (Nekrasova 1915). Although the species flowered in cultivation, its propagation was not successful enough to distribute the plants, as evident from the seed catalogues published for Olgino, in which the species was not listed (Fedtschenko 1909b, 1910, 1911, 1913).

In 1992, the species was successfully introduced from the Kazakhstan populations into the academic botanical garden of Almaty (Kazakhstan) (Ivashchenko 2005). The plants widely cultivated under the name *I. albomarginata* were proven to belong to *I. graeberiana* (syn. *I. zenaidae*); the correct species was introduced into commercial cultivation only recently (Rukšāns 2007).

Iris willmottiana

Iris willmottiana Foster was described from plants cultivated in van Tubergen's nursery of (Haarlem, Holland). The protologue stated that the plants were collected from the wild in 1899 by an unspecified collector of van Tubergen's nursery "in the mountains of Eastern Turkestan, occurring at a considerable height" (Foster 1901). Eastern

Fig. 2. Lectotype illustration of *Iris willmottiana* [from Foster (1901)].

Turkestan is an arid mountainous territory that is commonly associated with present-day Xinjiang in China, but juno irises are absent from that country (Mathew 1997) and its neighbouring territories (Lazkov & Sultanova 2014). From the compilation of botanical achievements of van Tubergen we learn that the species was collected by one of the most active collectors at van Tubergen's nursery, Paul L. Graeber, who was based in Tashkent and indeed travelled across a vast territory, "at one time going eastwards up to the frontiers of China and another time exploring Bokhara" (van Tubergen 1947: 5). Apparently, the provenance data were confused and cannot be taken as reliable in this case. In early garden publications and taxonomic treatments, the provenance of *I. willmottiana* was stated variably, as e.g. "the mountains of Eastern Turkestan in the neighbourhood of Tashkent" (Dykes 1913), which may indicate that the plant was actually collected in the Western Tian-Shan within present-day Uzbekistan or Kazakhstan and the statement of "eastern Turkestan" may have had quite another meaning than that of Xinjiang. The publication by van Tubergen (1947) states that *I. willmottiana* was collected in "Bokhara", probably meaning the Emirate of Bukhara, which included some mountains of the Pamir-Alay, and thus moving the type locality of the species quite far southwestwards.

Foster (1901) characterized the new species as relatively robust but compact ("the habit is that of *I. caucasica*"), with dark-green leaves ("the surface of the leaf is, perhaps, more glisten-

ing, devoid of the glaucous sheen”), 4–6 flowers on the stem, which are “sessile”, and the flower colour “lavender, or some similar tint of diluted purple, with blotches of white, mingled with marks of a deeper lavender on the blade of the fall”. A large drawing that accompanied the protologue, although monochrome, displayed a juno iris with very broad basal parts of the leaves and the outer segments of the perianth (falls) having a large discoloured spot in the middle part of the blade, decorated with paler and darker stripes along the claw, which is conspicuously winged (Fig. 2). Other contemporary publications from the British and Irish cultivation described and illustrated the same species (Foster 1904, Lynch 1904, Ball 1910).

Russian taxonomic works picked up this name almost immediately after its original publication, although without any assessment of its native distribution (Fedtschenko & Fedtschenko 1905). *Iris willmottiana* was first listed as presumably close to *I. coerulea* (now *I. albomarginata*), another blue-flowering species of juno irises in central Asia, and then tentatively placed into the synonymy of the latter (Fedtschenko 1909a). However, a detailed synopsis of Iridaceae in Russia (Fedtschenko 1924) accepted *I. willmottiana* again, as close to *I. coerulea* and with the provenance of “Turkestan”, which corresponded in that work to the Pamir–Alay mountain system.

Although Dykes (1913) stated that *I. willmottiana* was originally collected “in the neighbourhood of Tashkent”, the detailed treatment of *Iris* in that area by Vvedensky (1923) did not report this species but a very similar one, *I. coerulea*. Vvedensky (1935, 1941, 1971) was the first to interpret the native distribution of *I. willmottiana*. He considered it to be restricted to the Boysun Range within the Hissar Range in Uzbekistan, in the western Pamir–Alay.

Living plants of *I. willmottiana* were not known to Vvedensky (1935), and we are not aware of the reason for his interpretation of this name. Neither do we know the identity of the plants from the Boysun Range.

Nevertheless, Vvedensky (1941) made a note that the name *I. willmottiana* may appear to belong to a species from the Western Tian-Shan. So far it has not been reported from that area in

the taxonomic literature (e.g. Pavlov & Poliakov 1958, Vvedensky 1971, Abdulina 1999, Khasanov & Rakhimova 2014, Lazkov & Sultanova 2014), although it was treated as occurring in the Karatau Range, Kazakhstan (Rukšāns 2007) and later included in this circumscription in molecular phylogenetic works (Ikinci *et al.* 2011, Mavrodiev *et al.* 2014); but note that another phylogenetic work (Guo & Wilson 2013) used some uncertain material from Tajikistan which was named as *I. willmottiana* (which has never been reported from that country; Vvedensky 1963).

The plants of *Iris* subgen. *Scorpiris* recently collected from the northwestern parts of the Western Tian-Shan, from the Karatau and Boralday Ranges (Ivashchenko 2005, Rukšāns 2007), and also from the northern part of the Talas Range, have blue flowers with white-blotched blades of the outer segments of the perianth. Such plants were previously included in *Juno coerulea* (= *Iris albomarginata*) (Pavlov & Poliakov 1958, Vvedensky 1971, Ivashchenko 2005), which they resemble in the habit and the shape of leaves. They completely agree with the protologue and other early descriptions and photographs (Fig. 2) of *I. willmottiana* in the flower colour pattern, whereas the flowers of the typical *I. coerulea* lack prominent white blotches on the outer segments of the perianth. Flower colour is stable in populations from the Karatau Range (first author’s pers. obs.), and the distribution areas of the two flower variants do not overlap. We conclude that the two flower variants represent separate species, of which the northern one has been poorly recognised in the taxonomic literature; usually only a single blue-flowered species was reported from this part of the Western Tian-Shan (e.g. Pavlov & Poliakov 1958, Vvedensky 1935, 1941, 1971, Abdulina 1999), and it was only Ivashchenko (2005) who correctly recognised both species in Kazakhstan, but under wrong names. The name *I. willmottiana*, established on the basis of cultivated plants, is available for that species and is to be applied to it.

Iris willmottiana Foster (Fig. 3)

Gard. Chron., ser. 3, 29: 261. 1901, “Willmottiana” — *Juno willmottiana* (Foster) Vved. in Schreder, Fl. Uzbekistana 1:

Fig. 3. *Iris willmottiana* in flower (Kuyuk, Kazakhstan, 16 April 2015).

518. 1941, "Willmottiana". — TYPE: [icon] "*Iris Willmottiana*" in Foster (1901: Fig. 100) (lectotype designated by Boltenkov 2016: 231).

Juno coerulea auct. (Pavlov & Poliakov 1958: 250; Vvedensky 1971: 137; Ivashchenko 2005: 176).

Bulbs up to 3 cm in diameter, up to 3 cm long, ovoid. Bulb tunics not extended, papery, brown, up to 3 cm. Roots not markedly swollen. Scale leaves 2, membranous, clasping, brownish. Stem up to 30 cm above ground, internodes not visible or sometimes visible after anthesis. Leaves up to 9, developed by anthesis, dense, sometimes becoming slightly spaced after anthesis, clasping, falcate, broadly dilated at base, tapering at apex, lowermost ones up to 12 cm long, 2.5 cm wide, uppermost ones up to 8 cm long, 1.5 cm wide, rather dark-green above, glaucous-green below, with distinct white margins. Inflorescences with 1–3 (rarely 5–7) flowers which may emerge already from the second lower leaf. Bracts up to 5 cm long, 1 cm wide, lanceolate, green. Flowers ca. 5 cm in diameter; flower tube ca. 4 cm long, greenish; falls up to 4 cm long, claw up to 2.5 cm long, winged, nearly as wide as the blade, up to 1.8 cm wide, blue with thin darker stripes, blade up to 1.5 cm long, 0.9 cm wide, oblong, slightly emarginate at apex, blue, with a large white reniform spot in the middle part; crest ca. 1 cm long, dentate,

whitish; standards deflexed, up to 1.6 cm long, lanceolate, acute or trilobate at apex, pale blue. Style branches up to 3.5 cm long, with lobes ca. 1 cm long, 0.5 cm wide. Stamens with filaments up to 1 cm long, anthers up to 1.2 cm long. Pollen well-developed.

The species was named in honour of Ellen Ann Willmott (19 Aug. 1858–27 Sep. 1934), a prominent British horticulturist who was famous for numerous introductions of new plants (Le Lièvre 1980). The validating description of *Iris willmottiana* was based on living plants, and no specimens were cited in the protologue. An illustration published in the protologue was designated as the lectotype by Boltenkov (2016). That monochrome illustration clearly was not the basis of the original description as required by the definition of original material (Ross 2002), and the type designation has therefore the status of neotype (Art. 9.9). However, the lectotype may stand as such if the expanded definition of original material is accepted in the future, which allows illustrations published in the protologue be treated as part of original material (McNeill *et al.* 2016).

Whitish-flowered forms have been in cultivation already since the times of original introduction, along with the typical blue-flowered variety (Dykes 1913, van Tubergen 1947). Both colour

forms were observed in the Aksu-Jabagly Nature Reserve (Ivashchenko 2005).

DISTRIBUTION AND HABITAT. Western Tian-Shan (Karatau Minor, Karatau and Boraldai-Tau Ranges, foothills and the northern side of Talas Range) (Fig. 1). Near-endemic of Kazakhstan, also known from a single locality in Kyrgyzstan which is close to the country border. Reported from Kyrgyzstan for the first time here. Stony slopes in foothills or lower to middle mountain belts, at elevations of 900–1500(2500) m. Flowering from the end of March to the beginning of May.

SPECIMENS AND RECORDS. **Kazakhstan.** Karatau Mts.: Berkara, *J. Rukšāns* (Rukšāns 2007); Kuyuk Mts., Saisu, 25 May 1933 *N. Khlebnikova* (TASH!); Sayasu, 1990 *M. Chase I-75* (Rukšāns 2007, İkinci *et al.* 2011); Kuyuk Pass, 27 March 2016 *E. Davkaev* (Plantarium); Kuyuk, 16 April 2015 *G. Lazkov* (FRU!). Karatau Minor Mts.: Ulken-Buryltau Mts., 21 March 2016 *V. Kolbintsev* (Plantarium). Boraldai-Tau Range: Boraldai, 2500–6000', April 1872 *Korolkoff* (TASH!); Kenozo, 29 April 2007 & 1 May 2015 *E. Davkaev* (Plantarium); Nurbai Mt., 23 April 2012 *E. Davkaev* (Plantarium); Sartur Mts., Kulan River, 13 April 2012 *E. Davkaev* (Plantarium). Talas Range: Aksu-Jabagly Nature Reserve, Jabagly-Su River, June 1928 *Blagoveschensky* (TASH!); Jabagly-Su River, Kaindy, *E. Mokeeva 120* (TASH!); Ulken-Kaindy, 16 June 2012 *V. Kolbintsev* (Plantarium); Irgaily, 2 May 2013 *E. Davkaev* (Plantarium); Kishi-Kaindy, 1700 m, 24 June 1933 *I. Linczevsky 72* (TASH!); Kishi-Kaindy, 12 April 2013 *E. Davkaev* (Plantarium); Taldy-Bulak, 7 April 1934 *Butkov & Botschantzev 456* (TASH!); Karakus Mts., 9 April 2012, 20 April 2012 & 22 April 2014 *E. Davkaev* (Plantarium). **Kyrgyzstan.** Karatau Range: Karachat-Too Mts., near railway station Maimak, ca. 1100 m a.s.l., 25 March 2016 *G. Lazkov* (FRU!).

CULTIVATION. As evident from garden reports of the early 20th century (Foster 1901, 1904, Lynch 1904, Ball 1910), *I. willmottiana* was successfully cultivated in England after its introduction from the original cultivation in Holland (van Tubergen 1947). The early British cultivation included also the garden of Ellen Willmott at Warley Place, as documented by a specimen at BM ("Ex hort. Miss Willmott, Warley Place, Essex, 04.1902", BM001122715!). The species reportedly had disappeared from the Dutch cultivation (van Tubergen 1947) but its whitish-flowered variety survived. However, a recent propagation distributed as the whitish-flowered variety of *I. willmottiana* was found to be a garden hybrid (Rukšāns 2007). The British cul-

tivation of the species seems to have been stable (Mathew 1997); recently it was reintroduced from Kazakhstan (Rukšāns 2007). *Iris willmottiana* has been cultivated for a long time in academic botanical gardens of Tashkent (Uzbekistan), Kiev (Ukraine), Almaty (Kazakhstan), etc. (Ivashchenko 2005).

Identification key

Below we provide an identification key to the blue-flowered juno irises of the Western Tian-Shan, which have been treated collectively under the names *Iris coerulea* or *I. albomarginata*.

1. Falls in middle part of blade with a large white reniform spot with very sharp limits. Leaves tapering at apex, falcate, dense, internodes usually not visible (rarely slightly visible after anthesis in older plants) ... *Iris willmottiana*
1. Falls in middle part of blade unspotted, rarely with an indistinct pale spot with obscure limits. Leaves broadly or narrowly attenuated, rather straight, lax, internodes visible 2
2. Falls pale, blue or violet-blue with darker veins, unspotted, crest usually shortly fimbriate, rarely dentate. Leaves broadly attenuated, short-spaced, internodes shortly visible *Iris albomarginata*
2. Falls intensely coloured, violet, pale in middle part of blade, sometimes with a spot with obscure limits; crest usually dentate, rarely shortly fimbriate. Leaves narrowly attenuated, long-spaced, internodes well visible ..
..... *Iris graeberiana*

Discussion

According to the phylogenetic studies of İkinci *et al.* (2011), *I. albomarginata* and *I. willmottiana* are part of subclade D1 which includes both blue-flowered and yellow-flowered taxa from the Tian-Shan. They are genetically so close that their relative position on phylogenetic trees remains unresolved because of low statistical support (İkinci *et al.* 2011, Mavrodiev *et al.* 2014).

Mathew (1997) was in doubt about the taxonomic status of *I. albomarginata*, *I. graeberiana* and *I. willmottiana*, apparently because of their morphological similarity. We confirm that the three species are indeed distinct and have constant differences in flower colour and foliage. Their distributions are clearly allopatric, so that

no recent gene flow can be assumed between these species.

As noted recurrently by Vvedensky (1923, 1935, 1941, 1963, 1971), the most renowned expert in the taxonomy of juno irises of central Asia, examination of living plants is the only way to reliably distinguish the species. The reliable distinctions between *I. albomarginata*, *I. graeberiana* and *I. willmottiana* became clear with their cultivation and examination of plants in nature in several places within their distribution areas. It is also evident from this study that a special effort is required to match the historically cultivated juno irises with their wild populations.

Our study is partly based on public data resources. *Plantarium* (www.plantarium.ru), an open-access atlas of plants and lichens of Russia and adjacent countries, is being continuously complemented with valuable data on distribution records of all the native flora of the former USSR. This resource is screened and moderated by peers, supervisors and professional botanists, with every record being documented by high-quality field photographs, which ensures data quality very appropriate for scientific work. As currently basic botanical explorations are heavily underfunded, the efforts of skilful botanical enthusiasts make a valuable contribution to taxonomic botany and, as in the present study, can even be the main source of precise knowledge on plant distributions. It can be considered citizen science, which is being more actively used with the development of public online resources especially in biodiversity and conservation (Runnells *et al.* 2016).

Acknowledgements

We are grateful to plant enthusiasts from the project Plantarium (www.plantarium.ru) for a wealth of information accumulated in the resource, which includes not only collection data but also primary evaluations and revisions of identifications and the distributional information. Tony Hall (Kew) provided helpful and encouraging comments on the final draft version of this manuscript. Sampsa Lommi (Helsinki) produced the map.

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