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RESEARCH ARTICLE

A new synopsis of the genus *Lonicera* L. (Caprifoliaceae) in the flora of Uzbekistan

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Abstract

The taxonomic revision of *Lonicera* L. (Caprifoliaceae) in Uzbekistan was conducted based on field studies, a comprehensive analysis of herbarium material, and a critical review of the published literature. A total of 1223 herbarium specimens from national and international collections, including 915 specimens from Uzbekistan, were examined, resulting in the recognition of 10 *Lonicera* species for the country's flora. For each species, an identification key, updated nomenclature, and information on distribution, ecology, phenology, and conservation status are provided. The highest species diversity occurs in the Pamir–Alay mountain system, where all recorded species are present, including one endemic species restricted to this region. According to botanical–geographical zoning, *Lonicera* species diversity is higher in the Mountainous Middle Asia province than in the Turan province, with representatives distributed across 21 botanical–geographical districts. Particular attention is given to *Lonicera paradoxa* Pojark., a relic endemic species with a narrow distribution, assessed as Endangered (EN) on the IUCN Red List. This study contributes to the taxonomic reassessment of the Caprifoliace-

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ae in Uzbekistan and provides an updated and reliable taxonomic framework for the genus *Lonicera* in Central Asia.

Keywords
Central Asia, endemic species, *Lonicera paradoxa*, Pamir–Alay, plant conservation, taxonomic revision

Introduction

Lonicera L. is the largest genus of the family Caprifoliaceae and is represented by nearly 200 species worldwide (Theis et al. 2008; Takhtajan 2009; Tsarenko et al. 2020). Members of the genus are widely distributed across North Africa, Asia, and Europe, extending to North and Central America, as well as temperate and subtropical regions of Asia. Some species have expanded their ranges into tropical areas of India, Malaysia, and the Philippines (Rehder 1903; van Steenis 1946). Southeast Asia is considered the primary center of origin of the genus *Lonicera* (Tsarenko et al. 2020). Many species of *Lonicera* have medicinal value and contain biologically active compounds, including alkaloids and saponins. These species have long been used in traditional Chinese medicine as anti-inflammatory agents. Several species (*L. micrantha*, *L. caprifolium*, *L. ruprechtiana*, and *L. tatarica*) have been introduced into cultivation as ornamental plants due to their attractive flowers and fruits (Browicz 1976; Pojarkova 1958; Zaytsev 1962). At the same time, Japanese honeysuckle (*L. japonica* Thunb.), Amur bush honeysuckle (*L. maackii* Rupr.), Tartarian (*L. tatarica* L.) and, Morrow's honeysuckle (*L. morrowii* A. Gray), and their hybrid Bell's honeysuckle (*L.* × *bella* Zabel) have escaped cultivation in the United States and become economically damaging invasive species (Rose 2011).

According to the APG IV system (APG 2016) and recent phylogenetic studies of the order Dipsacales Juss. ex Bercht. et J. Presl, the genus *Lonicera* belongs to the tribe Caprifolieae within the family Caprifoliaceae Juss. (Theis et al. 2008; Takhtajan 2009; Reveal 2012). The morphology of fruits and seeds in *Lonicera* has been widely discussed in the literature and is regarded as an important set of characters supporting molecular phylogenetic results within Dipsacales (Bell et al. 2001, 2005; Donoghue 2003; Tsarenko et al. 2020).

Bondarenko (1961) recorded 20 species of *Lonicera* in the flora of Uzbekistan, of which 15 were native, while five species (*L. caprifolium*, *L. japonica*, *L. micrantha*, *L. ruprechtiana*, and *L. tatarica*) were introduced and widely cultivated in the country's botanical gardens and parks.

According to recent molecular phylogenetic and floristic studies, several species of the genus *Lonicera* (including *L. heterophylla* Decne., *L. karelinii* Bunge ex P. Kirillov, *L. anisotricha* Bondarenko, *L. cinerea* Pojark., and others) have been shown not to represent accepted taxa. Because these species form a single clade together with closely related taxa, their treatment as synonyms is considered justified (Wu et al. 2011; Tojibaev et al. 2021).

Scientific projects aimed at the critical reassessment of large taxonomic groups provide valuable opportunities to obtain new data on species composition and endemism, as well as to re-evaluate taxonomic status when necessary. The international "Flora of Uzbekistan" project, initiated in 2016 (Sennikov et al. 2016), serves as an important scientific framework for the comprehensive study of the region's botanically rich flora. Within the framework of this project, six volumes of the new Flora of Uzbekistan have been published (Sennikov 2017a, 2017b, 2019, 2022, 2023a, 2023b). The third volume presents a critical taxonomic revision of the family Caprifoliaceae, with particular emphasis on the genus *Lonicera*. This revised treatment differs substantially from that of the first edition of the Flora of Uzbekistan (Bondarenko 1961) and recognizes only 10 species of *Lonicera* within the flora of the country.

As a result of the revision of Caprifoliaceae, the species composition occurring in Uzbekistan has been clarified, and the taxonomic status of several Central Asian endemic species has been re-evaluated. In particular, *Lonicera paradoxa* Pojark. (*Lonicera* sect. *Alpigenae* Pojark. ex A. Byalt) It is a relict endemic species of Central Asia, distributed in the Alay, Turkestan, and Zarafshan ranges of the Pamir–Alay mountain system (Pojarkova 1946; Daminova et al. 2024). This species is included in the national Red Data Books of Uzbekistan (Lazkov 2019), Kyrgyzstan (Koblitskaya 2006), and Tajikistan (Rahimi 2017) and is regarded as a rare species threatened with extinction in the wild. It is also listed on the IUCN Red List as Endangered (Estwood 2009).

This study aims to: (1) conduct a critical revision of the taxonomic composition of the genus *Lonicera* within the flora of Uzbekistan; (2) analyze the geographical distribution of the species occurring in the country and develop their distribution maps.

Materials and methods

The field surveys were conducted across the entire territory of Uzbekistan, including the collection of herbarium material and plant photography. The coordinates of plant species were recorded using a GPS device. At the National Herbarium of Uzbekistan (TASH), more than 1,223 herbarium specimens belonging to 10 species of the genus *Lonicera* were examined (Fig. 1), of which 915 specimens were collected from the territory of Uzbekistan (Fig. 2). We also studied herbarium specimens of *Lonicera* stored in the Herbarium of the Komarov's Botanical Institute, Russia (LE), the Institute of Botany and Phytointroduction, Ministry of Education and Science, Kazakhstan (AA) and online herbarium of Moscow State University, Russia (MW) (https://plant.depo.msu.ru). We used Google Earth software to georeference the collection sites of historical herbarium specimens. A WGS84 Geographic coordinate system was used as a reference datum. As much literature review as possible have been used and considered in this study (Rehder 1903; Steenis 1946; Pojarkova

1958; Sheiko 2007; Mabberley 2008; Theis et al. 2008; Naugžemys et al. 2014). Furthermore, Floras of Central Asian countries (Bondarenko 1961; Tkaschenko 1962; Goloskokov 1965; Zaprjagaeva & Kochkareva 1988; Pratov 1987) and other publications covering check-lists of local floras in Uzbekistan (Zakirov 1961; Khassanov 1987; Tojibaev 2010; Beshko 2011) were consulted to confirm identification. Nomenclature of each species was checked with that given in the latest publications (Grubov 2002; Theis et al. 2008; Naugžemys et al. 2011, 2014). Websites of the International Plant Names Index (www.ipni.org/), The Plant List (www.theplantlist.org/), Catalogue of Life (www.catalogueoflife.org/), and Plants of the World online (https://powo.science.kew.org/) were consulted for updating species names.

Figure 1. Description is on the next page.

Figure 1. Morphological diversity of *Lonicera* species distributed in the flora of Uzbekistan: **A** – *L. altmannii* (N. Daminova), **B** – *L. bracteolaris* (N. Beshko), **C** – *L. caerulea* (V. Ivanov), **D** – *L. humilis* (V. Pankratov), **E** – *L. korolkowii* (N. Daminova), **F** – *L. microphylla* (N. Daminova), **G** – *L. nummulariifolia* (N. Daminova), **H** – *L. paradoxa* (N. Daminova), **I** – *L. olgae* (A. Naumenko), **J** – *L. webbiana* (N. Daminova).

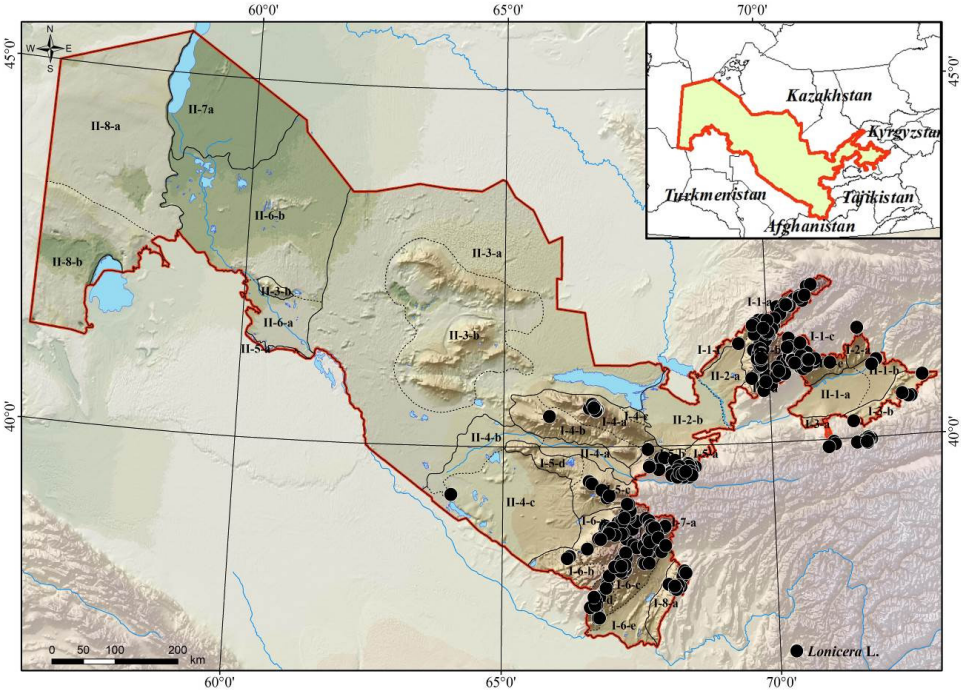

Figure 2. Localities of 915 herbarium specimens of *Lonicera* species in Uzbekistan, since 1909.

The taxonomic treatment of *Lonicera* in Uzbekistan includes a taxonomic synopsis with nomenclature, distributional, ecological and conservational information. Some illustrations were included when available. The main structure and format of the paper were consistent with The Flora of Uzbekistan project (Sennikov et al. 2016, 2017). Phytogeographical division of Uzbekistan provided by Tojibaev et al. (2016, 2017).

Analysis of the distribution of taxa across botanical–geographic regions

The distribution of *Lonicera* species across botanical–geographic regions was analyzed according to the botanical–geographic regionalization scheme of Uzbekistan proposed by K.Sh. Tojibaev et al. (2016, 2017).

The voucher data of herbarium specimens were georeferenced using Google Earth Pro 7.1. High-resolution distribution maps of the species were generated in ArcGIS version 10.8.1 based on occurrence points, using the WGS 1984 (World Geodetic System 1984) projection.

Results

***Lonicera* L.**

Sp. Pl. 1: 173 (1753).

Type: *Lonicera caprifolium* L.

Shrubs are erect or dwarf, rarely small trees, sometimes climbers, deciduous or evergreen. Branches hollow or solid with white or brown pith; winter buds with 1 to several pairs of scales, rounded or acutely 4-angular, inner scales sometimes accrescent and reflexed. Accessory buds are sometimes present, occasionally terminal buds are reduced and substituted by 2 lateral buds. Leaves opposite, rarely whorled, margin entire, rarely dentate or divided; leaves usually estipulate, occasionally with interpetiolar stipules or a swollen interpetiolar line; sometimes 1 or 2 pairs of leaves below the inflorescence are connate and form involucral bracts. Inflorescence thyrsoid, terminal or axillary, cymes opposite and usually reduced to paired flowers, rarely 1, sometimes 3-flowered. Inflorescence occasionally pedunculate; cymes sessile, sometimes forming a capitulum, or cymes pedunculate with a pair of bracts and 2 pairs of bracteoles; bracts usually small, sometimes leaflike; bracteoles usually free, sometimes ± fused and cupular, occasionally enclosing ovaries, sometimes absent. Paired flowers with free or partially to completely fused ovaries. Calyx 5-lobed, rarely 4-lobed, sometimes truncate, base occasionally with a collar-like emergence. Corolla white, yellow, reddish, or purple-red, often changing color after anthesis, campanulate, funnelform, regularly or subregularly 5(or 4)-lobed, or bilabiate and upper lip 4-lobed; tube long or short, often shallowly to deeply gibbous on ventral side toward base, rarely spurred. Nectary of compact sessile glandular hairs on the ventral side toward the base of the corolla tube, occasionally in 5 regular lines, rarely swollen at the base of the style. Stamens 5; anthers dorsifixed. Ovary 2 or 3(-5)-locular; style slender, hairy or glabrous; stigmas capitate. Fruit is a berry, red, blue-black, black, green, or white, sometimes pruinose, with bracteoles occasionally accrescent in fruit and enclosing paired berries. Seeds 1 to numerous, smooth, pitted or granular, with a rounded embryo.

The identification key and synopsis of *Lonicera* of the flora of Uzbekistan are presented below.

1 Leaves besides lower ones are sinuate-pinnated or pinnate..... ..... **8. *L. paradoxa***

– All leaves smooth-edged..... **2**

2 Branches hollow. Ovaries and fruits are free or adnate at the base at one point ***3***

– Branches fulfilled by white medulla..... **4**

3 Stems are short, 1–3 mm long. Calyx lobes are equal to the ovaries. Corolla white or rose, densely velvety-pilose outside. Fruits whitish..... ..... **10. *L. nummulariifolia***

– Stems lengthy up to 25 mm long. Calyx lobes are visibly shorter than the ovaries. Corolla rose or white, outside naked or weakly pilose; tube naked or weakly pilose. Fruits are red, rarely yellow..... ..... ***9. L. korolkowii***

4(2) All 4 bracts of both flowers are adnate to a globose wrap, with free ovaries inside. Later on, the enlarged wrap became blackish-blue, waxy, and juicy infructescence ..... **2. *L. caerulea***

– Bracts free or pairwise adnate, or completely absent..... **5**

5 Sprouts ended by 1 apical bud **6**

– Sprouts ended by 2 opposite axillary buds..... **7**

6 Leaves small, 0.6–3(4) cm long. Flowers pale, greenish or yellowish with calyx lobes shorter than the tube. Bracts are usually absent..... ..... **1. *L. microphylla***

– Leaves larger, 2.5–12 cm long. Flowers are dirty violet-purple or dirty rose, with calyx lobes 1.5-3 times as long as the tube. Bracts are always present. ..... **7. *L. webbiana***

7(5) Winter buds longer than petioles or equal to 2 external scales, adnate in cap..... **8**

– Winter buds shorter than petioles with several pairs free, opposite scales.. ..... **9**

8 Leaves naked or slightly pilose. Corolla tube short, equal to lobes..... ..... **4. *L. bracteolaris***

– Leaves with setaceous margins, sometimes appressed pilose. Corolla tube 1.5 times longer than lobes..... **5. *L. olgae***

9(7) Corolla lobes equal to tube with a lower turndown lip. Stems 5–10 (20) mm long. Leaves are widely ovate to rounded, with a wide base. Shrub 80–120 cm tall. Fruits orange-red ..... **3. *L. altmannii***

– Corolla lobes 1.5–2 times shorter than the narrow cylindrical tube with slightly deflexed lower lip. Flowers sessile, stems up to 5 mm long. Leaves are prolonged, ovate-elliptical with a wedge-shaped, rounded base. Low shrub up to 70 cm tall. Fruits red ..... **6. *L. humilis***

1. *Lonicera microphylla* Willd. ex Schult.

Syst. Veg. 5: 258 (1819); Pojarkova in Fl. URSS 23: 482 (1958); Bondarenko in Fl. Uzbekistan 5: 564 (1961); Pratov in Opred. Rast. Sred. Azii 9: 331 (1987).

Type: Russia «Habitat in Sibiria orientali», Pallas (Holotype B-Willd 04182).

= *Lonicera simulatrix* Pojark. in Fl. USSR 23: 729 (1958); Bondarenko in Flora of Uzbekistan, vol. 5: 564 (1961); Pratov in Opred. Rast. Sred. Azii 9: 331 (1987).

Type: Kyrgyzstan. Asia media, jugum Alaicum, in valle fl. Taldyk-su (Gulcza), prope Ak-Bosoga, in declivi boreali, ca. 3000 m s. m., 29.06.1901, Alexeenko 1176 (Holotype LE).

Phenology. Fl. V–VI; fr. VII–IX.

Ecology. On the stony slopes, forest edges of the tree-shrub belt (1100–2800 m).

Distribution. Siberia, Mongolia, China, Afghanistan, India, Pakistan, Middle Asia (Kazakh lower mountains, Saur, Tarbagatay, Dzungarskiy Alatau, Tien-Shan, Pamir-Alay): Kazakhstan, Kyrgyzstan, Tajikistan, and Uzbekistan.

Distribution in Uzbekistan. Fergana, Jizzak, Namangan, Surkhandarya, Tashkent.

Distribution across botanical–geographical regions: I-1-a, I-1-b, I-1-c, I-1-d, I-1-e, I-2-a, I-3-b, I-5-a, I-7-a. (Table 1; Figure 3).

2. *Lonicera caerulea* L.

Sp. Pl. 1: 174 (1753); Pojarkova in Fl. URSS 23: 500 (1958).

Described from Switzerland. Type not indicated.

= *Lonicera stenantha* Pojark. in Bot. Zhurn. (Moscow & Leningrad) 20: 145 (1935); Pojarkova in Fl. URSS 23: 497 (1958); Bondarenko in Fl. Uzbekistan 5: 567 (1961); Pratov in Opred. Rast. Sred. Azii 9: 332 (1987).

Type: Tajikistan. Yashilkul lake, river head of Gunt, 12.24.06.1913, D.A.Bukinich (Holotype LE).

Phenology. Fl. IV–VI; fr. VII–IX.

Ecology. By the river valleys within tree-shrub vegetation, on the slide-rocks (1200–2700 m).

Distribution. Central and Eastern Europe, Afghanistan, Iran, Siberia, Mongolia, Pakistan, China, Japan, Korea, North America, Middle Asia (Kazakh lower mountains, Western Tien Shan, Pamir-Alay): Kazakhstan, Kyrgyzstan, Tajikistan, Uzbekistan.

Distribution in Uzbekistan. Surkhandarya, Tashkent.

Distribution across botanical–geographical regions: I-1-a, I-6-c (Table 1; Figure 4).

3. *Lonicera altmannii* Regel & Schmalh.

Trudy Imp. S.-Peterburgsk. Bot. Sada 5(2): 610 (1878); Pojarkova in Fl. URSS 23: 517 (1958); Bondarenko in Fl. Uzbekistan 5: 568 (1961); Pratov in Opred. Rast. Sred. Azii 9: 331 (1987).

Type: Kazakhstan. Dzhungarskiy Alatau: Dzhasykkul, 03.05.1873, Kuschakewicz (Lectotype LE, designated by Pojarkova in Bot. Zhurn. (Moscow & Leningrad) 20: 148 (1935)).

= *Lonicera altmannii* var. *saravshanica* Rehder in Ann. Report Missouri Bot. Gard. 14: 88 (1903). – *Lonicera saravshanica* (Rehder) Pojark. in Bot. Zhurn. (Moscow & Leningrad) 20: 145 (1935), "*zeravshanica*"; Pojarkova in Fl. URSS 23: 519 (1958), "*zaravschanica*"; Bondarenko in Fl. Uzbekistan 5: 560 (1961); Pratov in Opred. Rast. Sred. Azii 9: 334 (1987).

Type: Tajikistan. Marguzor lake, 01.06.1892, V.L.Komarov (Lectotype LE, designated by Pojarkova in Bot. Zhurn. (Moscow & Leningrad) 20: 147 (1935)).

= *Lonicera tianschanica* Pojark. in Bot. Zhurn. (Moscow & Leningrad) 20: 147 (1935).

Type: Uzbekistan. Santash on Chirchik river, 25.06.1881, A. Regel (Holotype LE).

Phenology. Fl. V–VIII; fr. VII–IX.

Ecology. Forest edges, in the forests and within shrubs (800–3000 m).

Distribution. China (Xinjiang), Middle Asia (Dzungar Alatau, Tien-Shan, North Pamir-Alay): Kazakhstan, Kyrgyzstan, Tajikistan, Uzbekistan.

Distribution in Uzbekistan. Fergana, Jizzak, Kashkadarya, Namangan, Samarkand, Surkhandarya, Tashkent.

Distribution across botanical–geographical regions: I-1-a, I-1-b, I-1-c, I-1-d, I-2-a, I-3-b, I-4-a, I-5-a, I-5-b, I-5-c, I-6-a, I-6-c (Table 1; Figure 5).

4. *Lonicera bracteolaris* Boiss. & Buhse

Nouv. Mém. Soc. Imp. Naturalistes Moscou 12: 106 (1860); Pojarkova in Fl. URSS 23: 521 (1958); Bondarenko in Fl. Uzbekistan 5: 570 (1961); Pratov in Opred. Rast. Sred. Azii 9: 334 (1987).

Type: Azerbaijan. «Karabagh, bei Tassakend, 24.05.1847, F. Buhse (Holotype G, Isotype LE).

Phenology. Fl. V–VI; fr. VII–IX.

Ecology. On the rocks and stony slopes (1500–3000 m).

Distribution. Caucasus, Afghanistan, Iran, Middle Asia (Tien-Shan, Pamir-Alay, Kopetdag): Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan, Uzbekistan.

Distribution in Uzbekistan. Fergana, Jizzak, Kashkadarya, Namangan, Surkhandarya.

Distribution across botanical–geographical regions: I-1-e, I-3-b, I-4-a, I-5-a, I-6-a, I-6-c (Table 1; Figure 6).

5. *Lonicera olgae* Regel & Schmalh.

Trudy Imp. S.-Peterburgsk. Bot. Sada 5: 609 (1877); Pojarkova in Fl. URSS 23: 524 (1958); Bondarenko in Fl. Uzbekistan 5: 570 (1961); Pratov in Opred. Rast. Sred. Azii 9: 335 (1987).

Type: Tajikistan. Hissar ridge: pass Kafaraga, 20.06.1870, O. Fedtschenko (LE, MW).

Phenology. Fl. VII; fr. VII–IX.

Ecology. In the clefts of the alpine zone (2500–3400 m).

Distribution. Middle Asia (Western Tien-Shan, Pamir-Alay): Kazakhstan, Kyrgyzstan, Tajikistan, Uzbekistan.

Distribution in Uzbekistan. Jizzak, Tashkent.

Distribution across botanical–geographical regions: I-1-b, I-1-c, I-5-a (Table 1; Figure 7).

6. *Lonicera humilis* Kar. & Kir.

Bull. Soc. Imp. Naturalistes Moscou 15: 370 (1842); Pojarkova in Fl. URSS 23: 525 (1958); Pratov in Opred. Rast. Sred. Azii 9: 335 (1987).

Type: Kazakhstan. "In subalpinis rupibus Alatau ad dextram ripam fl. Sarchan", 1841, Karelin, Kirilov 1551 (holotype LE, isotype MW).

= *Lonicera cinerea* Pojark. in Fl. URSS 23: 736 (1958); Bondarenko in Fl. Uzbekistan 5: 569 (1961); Pratov in Opred. Rast. Sred. Azii 9: 335 (1987).

Type: Kazakhstan. Kyrgyz ridge: Sulutor valley, steppe, 950 m., 01.06.1930, F. Zaprjagaev 41 (Holotype and Isotypes LE).

Phenology. Fl. V–VI; fr. VII–IX.

Ecology. On the stony slopes (1100–2800 m).

Distribution. Afghanistan, China (Xinjiang), Middle Asia (Tien Shan, Pamir-Alay): Kazakhstan, Kyrgyzstan, Uzbekistan.

Distribution in Uzbekistan. Fergana, Jizzak, Tashkent.

Distribution across botanical–geographical regions: I-1-a, I-1-b, I-1-c, I-3-b, I-5-a (Table 1; Figure 8).

7. *Lonicera webbiana* Wall. ex DC.

Prodr. 4: 336 (1830).

Type: India, Jammu and Kashmir: Srinagar, W.S. Webb in Wallich Cat., 476 (Holotype G-DC).

= *Lonicera heterophylla* Decne. in Jacq., Voy. Inde 4(Bot.): 80, t. 88 (1844); Bondarenko in Fl. Uzbekistan 5: 571 (1961).

Described from India, Type: V. Jacquemont 498 (P).

= *Lonicera karelinii* Bunge ex P. Kir., Lonic. Russ. Reich.: 33 (1849); Pojarkova in Fl. URSS 23: 530 (1958); Pratov in Opred. Rast. Sred. Azii 9: 332 (1987). – *Lonicera heterophylla* var. *karelinii* (Bunge ex P. Kir.) Rehder in Ann. Report Missouri Bot. Gard. 14: 110 (1903).

Type: Kazakhstan. "In subalpinis Alatau ad fl. Lepsa", 1841, Karelin, Kirilov 1555 (Holotype LE, Isotype MW).

= *Lonicera anisotricha* Bondarenko in Fl. Uzbekistan 5: 643 (1961); Pratov in Opred. Rast. Sred. Azii 9: 336 (1987).

Type: Uzbekistan. Chatkel ridge.: Parkent region, Sukok river basin, Myskent say, 27.07.1938, Saranskaya, Klima 399 (Holotype TASH).

Phenology. Fl., fr. VII–IX.

Ecology. In the juniper forests, in the subalpine and alpine zones (1500–3400 m).

Distribution. Afghanistan, India, Pakistan, Bhutan, China, Middle Asia (Dzhungar Alatau, Tien Shan, North Pamir-Alay): Kazakhstan, Kyrgyzstan, Tajikistan, Uzbekistan.

Distribution in Uzbekistan. Fergana, Namangan, Tashkent.

Distribution across botanical–geographical regions: I-1-b, I-1-c, I-1-d, I-1-e, I-3-b (Table 1; Figure 9).

8. *Lonicera paradoxa* Pojark.

Bot. Mater. Gerb. Bot. Inst. Komarova Akad. Nauk S.S.S.R. 11: 210 (1946); Pojarkova in Fl. URSS 23: 534 (1958); Bondarenko in Fl. Uzbekistan 5: 572 (1961); Pratov in Opred. Rast. Sred. Azii 9: 336 (1987).

Type: Kyrgyzstan. Turkestan ridge. river Mynteke, 2800 m, 11.09.1940, E.Varivtseva, G.Neply 219 (Holotype LE).

Phenology. Fl., fr. VIII–IX.
Ecology. On the stony slopes (1600–2800 m.).
Distribution. Middle Asia (Pamir-Alay): Kyrgyzstan, Tajikistan, Uzbekistan.
Distribution in Uzbekistan. Fergana, Jizzak.
Distribution across botanical–geographical regions: I-3-b, I-5-a (Table 1; Figure 10).

9. *Lonicera korolkowii* Stapf

Gard. & Forest 7: 34 (1894); Pojarkova in Fl. URSS 23: 548 (1958); Bondarenko in Fl. Uzbekistan 5: 573 (1961); Pratov in Opred. Rast. Sred. Azii 9: 337 (1987).

Described from cultivated trees, collected most probably from Uzbekistan (between Tashkent and Burchmulla village) by N.I. Korolkov and sent to France (Arboretum de Segrez), where from plants have been sent for cultivation to USA (Arnold Arboretum). Type material from cultivated plants in Arnold Arboretum (K).

= *Lonicera lanata* Pojark. in Fl. URSS 23: 737 (1958).

Type: Uzbekistan. River side of Chirchik, near Baytkurgan, 27.04.1914, A.Michaylov in Herb. Minkwitz 940 (Holotype LE).

Phenology. Fl. V–VI; fr. VI–IX.
Ecology. Under the rocks within forests from the middle up to alpine zones (400-3000 m).
Distribution. Afghanistan, Pakistan, Middle Asia (Tien-Shan, North Pamir-Alay): Kazakhstan, Kyrgyzstan, Tajikistan, Uzbekistan.
Distribution in Uzbekistan. Andijan, Fergana, Jizzak, Namangan, Tashkent.
Distribution across botanical–geographical regions: I-1-a, I-1-e, I-1-f, I-2-a, I-3-b, I-5-a, II-1-b (Table 1; Figure 11).

10. *Lonicera nummulariifolia* Jaub. & Spach

Ill. Pl. Orient. 1: 133 (1843); Pojarkova in Fl. URSS 23: 566 (1958); Bondarenko in Fl. Uzbekistan 5: 574 (1961); Pratov in Opred. Rast. Sred. Azii 9: 337 (1987).

Described from Lebanon and Asia Minor. Type not designated.

Phenology. Fl. V–VI; fr. VIII–IX.

Ecology. By the river stony valleys and forests up to subalpine zone (1300–3000 m).

Distribution. Lebanon, Iraq, Syria, Turkey, Iran, Afghanistan, Middle Asia (Pamir-Alay): Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan, Uzbekistan.

Distribution in Uzbekistan. Andijan, Fergana, Jizzak, Kashkadarya, Namangan, Samarkand, Surkhandarya, Tashkent.

Distribution across botanical–geographical regions: I-1-a, I-1-b, I-1-c, I-1-d, I-1-e, I-2-a, I-3-a, I-3-b, I-4-a, I-5-a, I-5-b, I-5-c, I-6-a, I-6-b, I-6-c, I-6-d, I-7-a, I-8-a (Table 1; Figure 12).

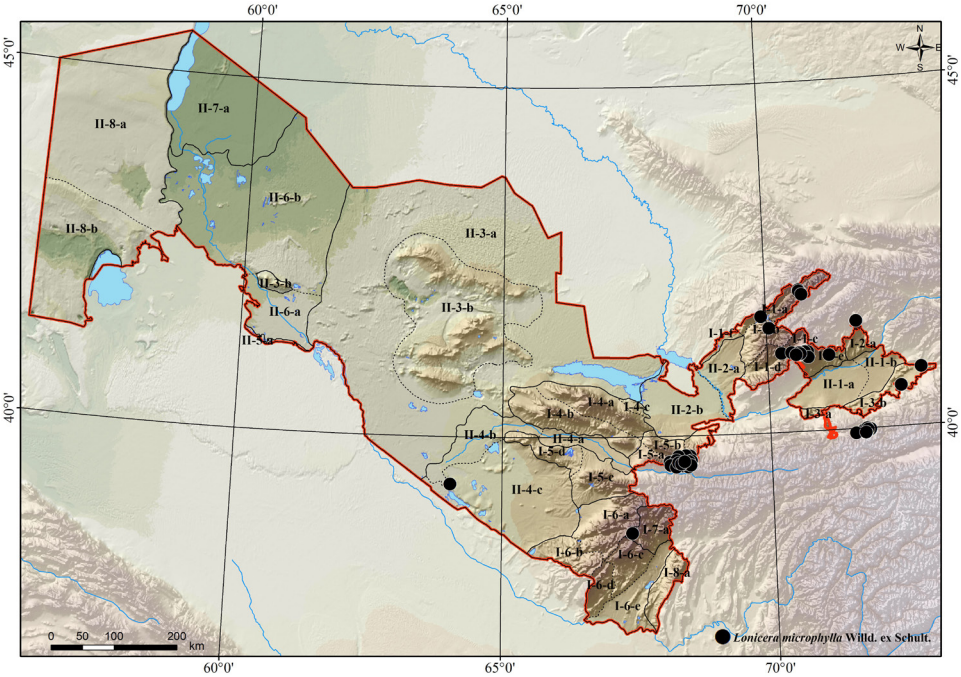

Figure 3. Distribution map of *Lonicera microphylla* in Uzbekistan by botanical-geographical regions.

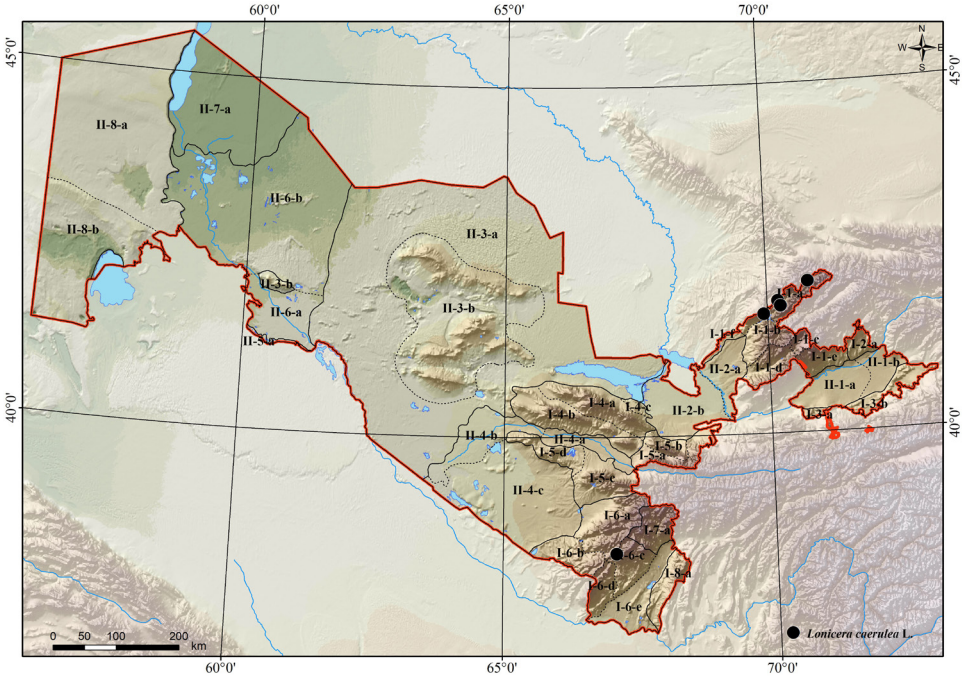

Figure 4. Distribution map of *Lonicera caerulea* in Uzbekistan by botanical-geographical regions.

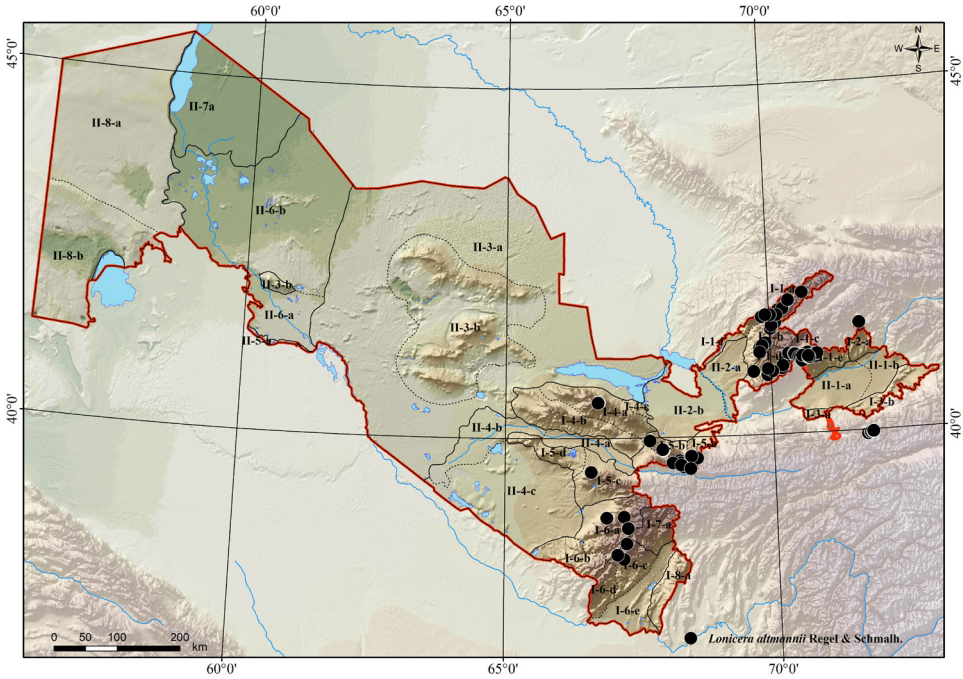

Figure 5. Distribution map of *Lonicera altmannii* in Uzbekistan by botanical-geographical regions.

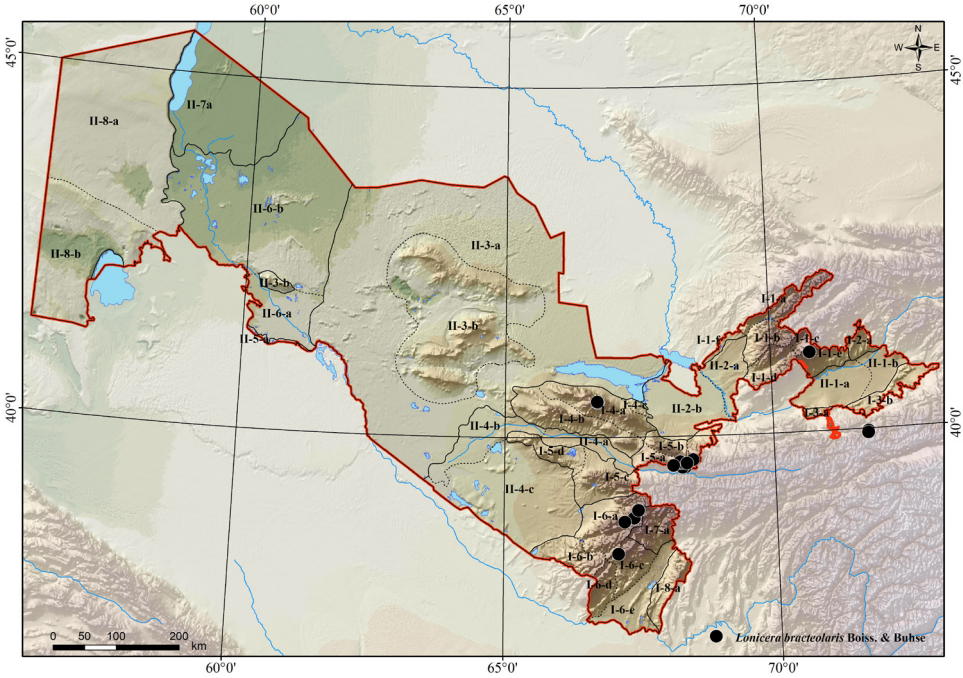

Figure 6. Distribution map of *Lonicera bracteolaris* in Uzbekistan by botanical-geographical regions.

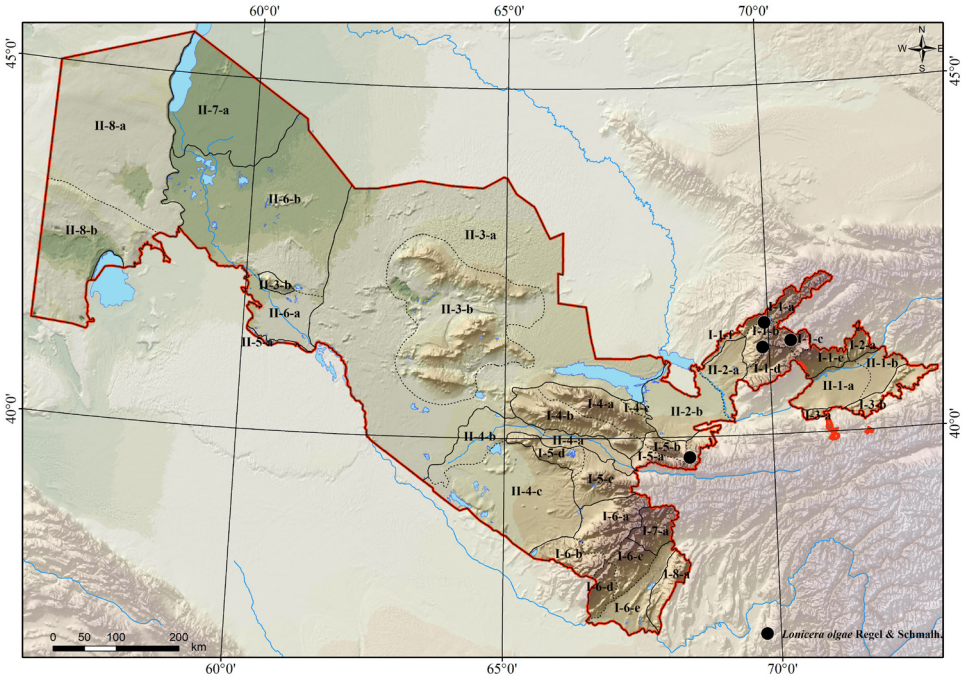

Figure 7. Distribution map of *Lonicera olgae* in Uzbekistan by botanical-geographical regions.

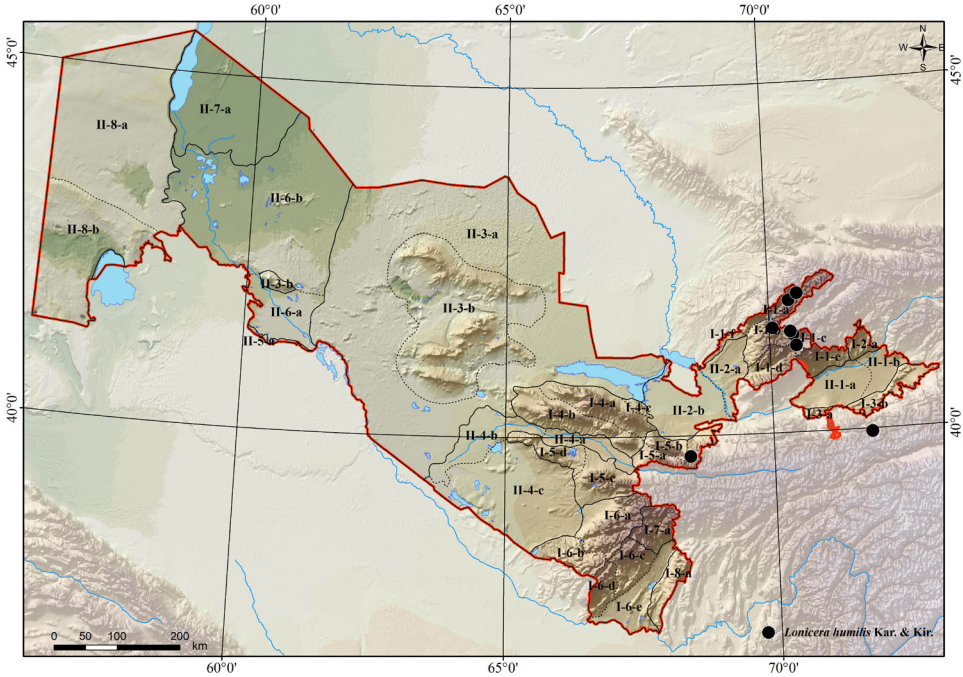

Figure 8. Distribution map of *Lonicera humilis* in Uzbekistan by botanical-geographical regions.

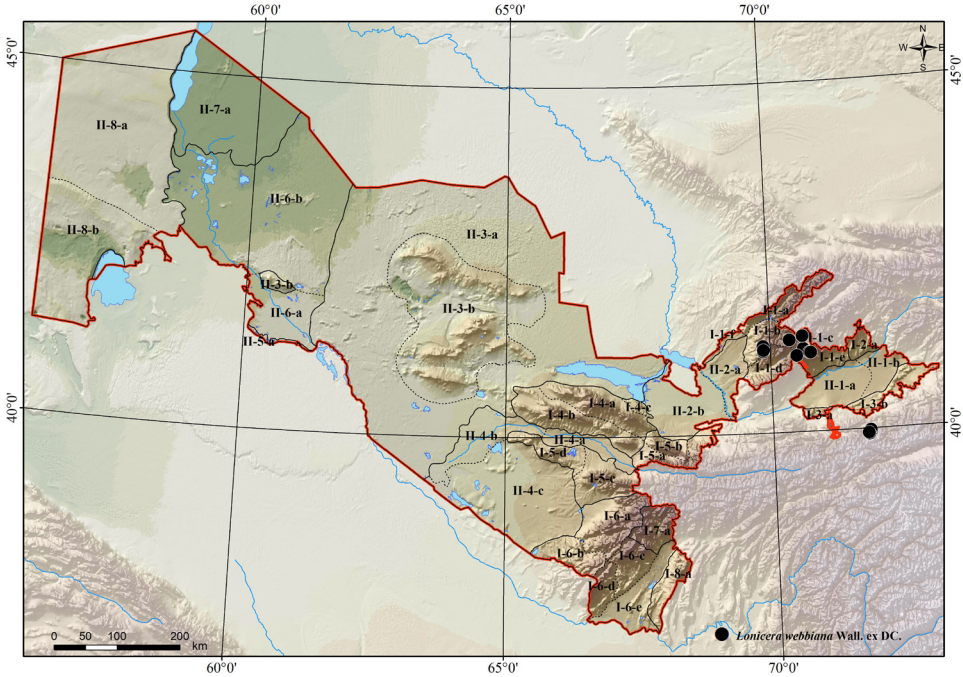

Figure 9. Distribution map of *Lonicera webbiana* in Uzbekistan by botanical-geographical regions.

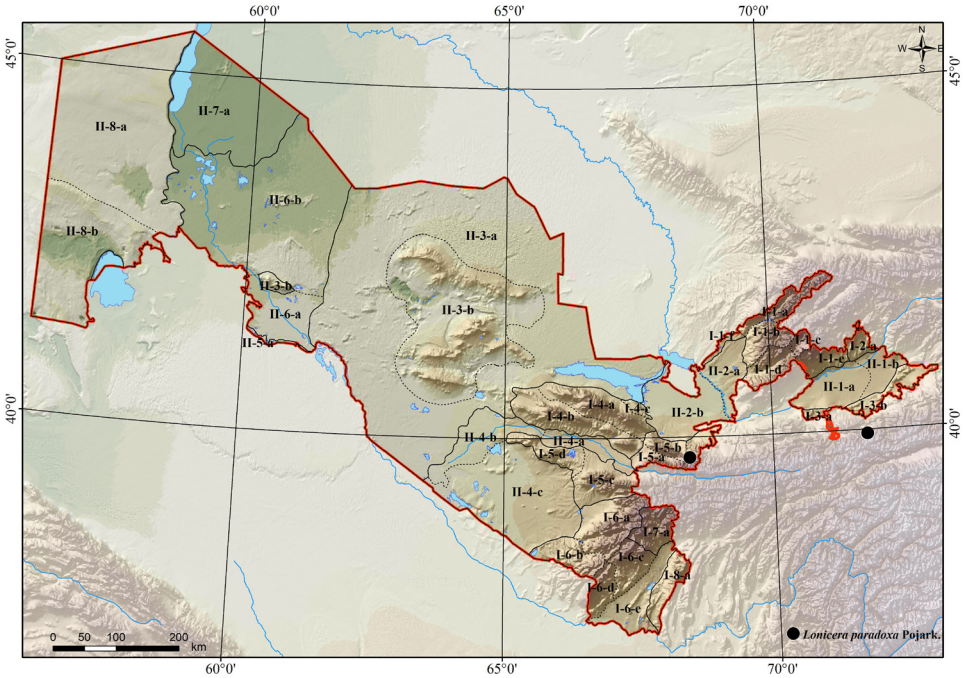

Figure 10. Distribution map of *Lonicera paradoxa* in Uzbekistan by botanical-geographical regions.

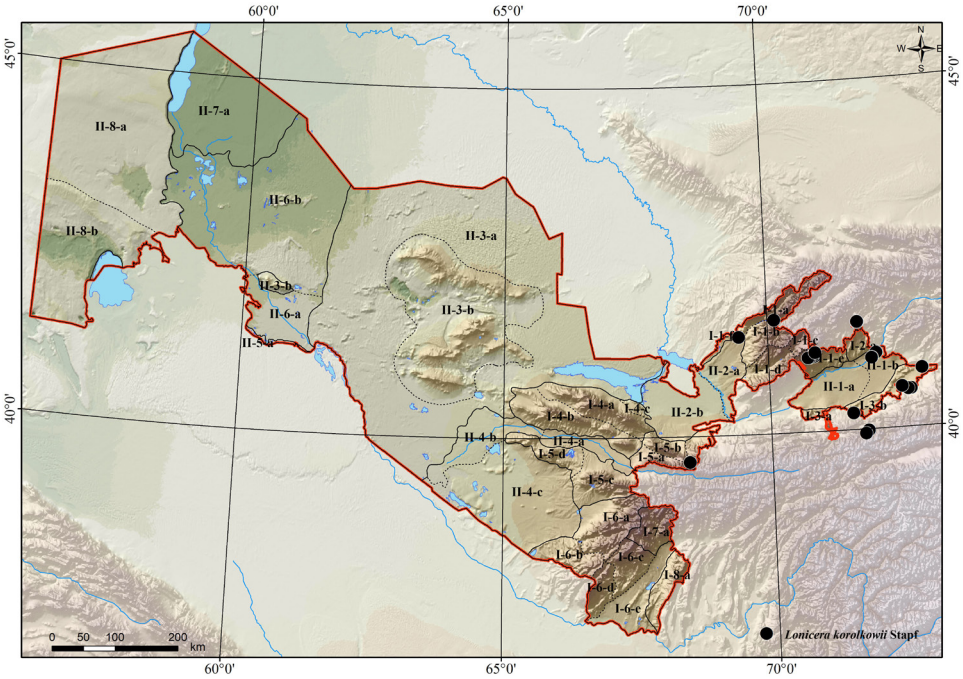

Figure 11. Distribution map of *Lonicera korolkowii* in Uzbekistan by botanical-geographical regions.

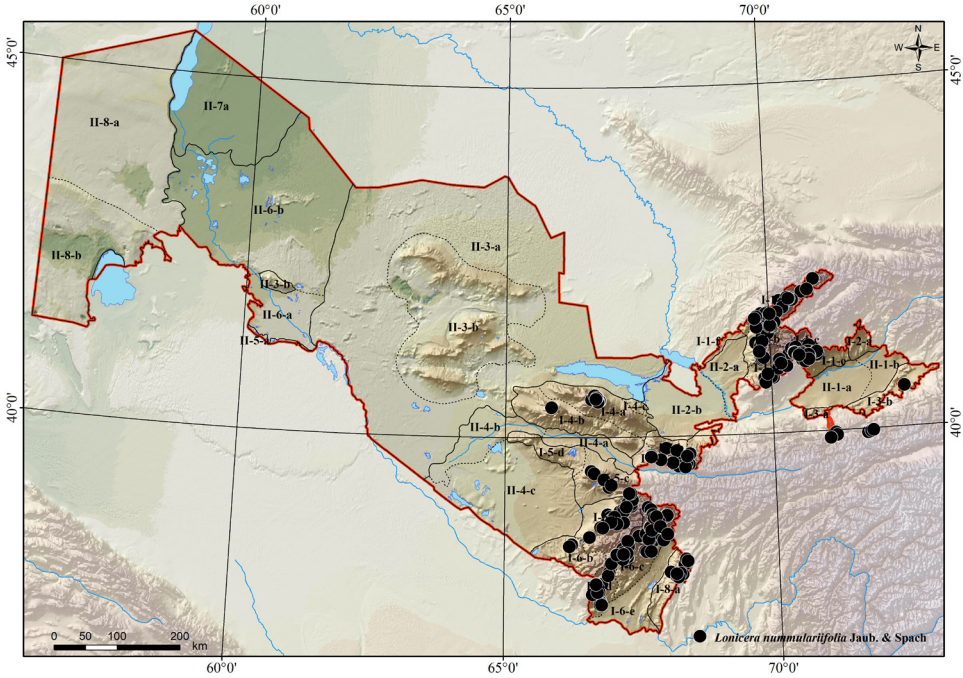

Figure 12. Distribution map of *Lonicera nummulariifolia* in Uzbekistan by botanical-geographical regions.

Distribution by Botanical and Geographical Regions

In Uzbekistan, *Lonicera* species have been recorded in 21 botanical–geographical districts. Only one district exhibits the complete species composition (100%), whereas approximately 60% of the species occur in five districts; in the remaining sixteen districts, the occurrence of *Lonicera* species ranges from 10% to 40%. The highest diversity of *Lonicera* species in Uzbekistan is observed in the Pamir–Alay mountain system, followed by the Tien Shan mountain system (Mountainous Middle Asia province sensu Kamelin, 1973). The Pamir–Alay Mountains are the richest region for Lonicera diversity, and all *Lonicera* species recorded in Uzbekistan's flora are found within this area. Only one species (*L. paradoxa*) is endemic to the Pamir–Alay Mountains. Nine species also occur in the Tien Shan, indicating that these species are shared between the two mountain systems (Table 1).

In the mountainous regions of Uzbekistan, particularly within the mid-altitudinal belts, climatic conditions are favourable for *Lonicera* species, which are mainly associated with deciduous forest communities. According to the botanical-geographical zoning, the Mountainous Middle Asia province exhibits high phylogenetic diversity, with species richness ranging from 1 to 10 across its districts. The highest diversity is recorded in the Pamir–Alay system: 10 species in the Eastern

Alay (I-3-b) district and 8 species in North Turkestan (I-5-a). In other districts, including Western Alay (I-3-a), Nuratau (I-4-a), Aktau (I-4-b), Malguzar (I-5-b), Urgut (I-5-c), Kashkadarya (I-6-a), Tarkapchigay (I-6-b), Baysun (I-6-c), Kuhitang (I-6-d), Sangardak-Tupalang (I-7-a), and Babatag (I-8-a), species numbers decline from three to one.

Table 1. Distribution of species by botanical and geographical regions of Uzbekistan

Botanical- geographical districts	Species (specimens) number	Botanical- geographical region	Species (specimens) number
I. Mountain Central Asian province			
Tien Shan Mountain system			
I-1 Western Tien- Shan	8 (190)	I-1-a Ugam-Pskem	6 (70)
		I-1-b Western Chatkal	6 (53)
		I-1-d Kurama	4 (51)
		I-1-c Arashan	6 (19)
		I-1-e Chorkesar	6 (145)
		I-1-f Tashkent	1 (1)
I-2 Fergana	1 (1)	I-2-a South- Chatkal	3 (13)
Pamir-Alay Mountain system			
I-3 Fergana-Alay	10 (134)	I-3-a Western Alay	1 (6)
		I-3-b Eastern Alay	10 (128)
I-4 Nuratau	3 (24)	I-4-a Nuratau	3 (21)
		I-4-b Aktau	1 (3)
I-5 Kuhistan	8 (217)	I-5-a North Turkestan	8 (181)
		I-5-b Malguzar	3 (26)
		I-5-c Urgut	2 (9)
I-6 Western Hissar	3 (112)	I-6-a Kashkadarya	3 (47)
		I-6-b Tarkapchigay	1 (2)
		I-6-c Baysun	3 (38)
		I-6-d Kuhitang	1 (25)
I-7 Hissar-Darvaz	1 (34)	I-7-a Sangardak-Tupalang	1 (34)
I-8 Panj	1 (35)	I-8-a Babatag	1 (35)
II. Turan province			
II-1 Central Fergana	1 (7)	II-1-b Eas Fergana	1 (7)

Within the Tien Shan system, *Lonicera* species occur at 1–6 per district. The highest richness is observed in Ugam–Pskem (I-1-a, 6 species, 70 specimens), Western Chatkal (I-1-b, 6 species, 53 specimens), Arashan (I-1-c, 6 species, 19 speci-

mens), and Chorkesar (I-1-e, 6 species, 145 specimens). In contrast, Kurama (I-1-d), Tashkent (I-1-f), and South Chatkal (I-2-a) districts host only 1–4 species.

In the Turan Province, the species diversity of *Lonicera* is extremely low with only a single species of this genus recorded in the II-1-b area of Central Fergana.

Discussion

Within the framework of this study, the taxonomic composition and distribution of the genus *Lonicera* in Uzbekistan were comprehensively revised, and floristic, ecological, and phytogeographical patterns were clarified. The recognition of only 10 species of *Lonicera* in the country is consistent with the results of recent molecular phylogenetic studies and indicates that several taxa previously treated as independent species actually represent synonyms within broader species complexes (Wu et al. 2011; Naugžemys et al. 2011; Tojibaev et al. 2021).

In comparison with the data presented by Bondarenko (1961), the reduction in the number of recognized species suggests that diversity was overestimated in traditional classifications based primarily on morphological characters. Taxa such as *Lonicera heterophylla*, *L. karelinii*, *L. anisotricha*, *L. cinerea*, and *L. simulatrix*, which were separated on the basis of leaf shape, degree of pubescence, and certain floral traits, are characterized by a high level of ecological and morphological variability. Consequently, their recognition as independent species does not conform to modern taxonomic concepts. The treatment of these taxa as synonyms within *L. webbiana*, *L. humilis*, and *L. microphylla* is consistent with contemporary approaches to the study of the flora of Central Asia (Theis et al. 2008; Tsarenko et al. 2020).

Botanical–geographical analysis demonstrated that the main diversity of *Lonicera* species is concentrated in mountainous regions, particularly within the Pamir–Alay mountain system. This system encompasses all *Lonicera* species recorded in Uzbekistan and represents the principal center of diversity for the genus in the country. The high species richness observed in the Eastern Alay (I-3-b) and Northern Turkestan (I-5-a) regions can be explained by their complex topography, wide altitudinal range, and the diversity of forest and shrubland habitats (Kamelin 1973; Tojibaev et al. 2016).

In the Tien Shan mountain system, *Lonicera* species occur less frequently overall; however, relatively high species richness is maintained in the Ugam–Pskem, Western Chatkal, Arashan, and Chorkesar regions, which is associated with favorable ecological conditions in these areas. At the same time, the absence of some Pamir–Alay species from the Tien Shan indicates the presence of historical phytogeographical differentiation between these two mountain systems.

In Uzbekistan, species of the genus *Lonicera* are distributed across an elevational range of 400–3400 m a.s.l., with the majority occurring in the middle and high mountain zones. The main concentration of species falls within the 1300–3000 m elevational range. Analysis of species-specific altitudinal distributions indicates

that the mean elevational occurrence of the genus *Lonicera* is approximately 2125 m a.s.l. Ecologically, *Lonicera* species are primarily associated with deciduous and juniper forests, forest margins, and moist rocky slopes. The sharp decline in species occurrence in lowland and arid regions clearly demonstrates their predominantly mesophytic ecological requirements and limited adaptation to xeric conditions.

The near absence of the genus *Lonicera* in the Turan Province indicates that desert and semi-desert landscapes constitute strong ecological barriers for representatives of this genus. This pattern is also typical of other mesophytic woody genera in Central Asia and highlights the importance of mountainous regions as long-term refugia (Kamelin 1973; Tojibaev et al. 2017).

In Uzbekistan, *Lonicera paradoxa* is the only endemic species, with a distribution restricted to the Pamir–Alay mountain system. The narrow extent of its range and the fragmentation of its populations underline the particular importance of this species from a conservation perspective. *Lonicera paradoxa* is included in national Red Data Books and is assessed by the International Union for Conservation of Nature (IUCN) as a species threatened with extinction (Estwood 2009; Lazkov 2019).

The results of this study clearly demonstrate the scientific productivity and research efficacy of the Flora of Uzbekistan project through the critical re-examination of herbarium specimens collected over more than a century, the development of GIS-based distribution maps, and the integration of contemporary taxonomic approaches. The compiled data on species composition and distribution provide a robust and reliable scientific foundation for ecological modeling, the formulation of conservation strategies, and comparative phytogeographic studies across Central Asia.

Conclusion

Uzbekistan is among the Central Asian countries with the highest species diversity; however, many issues related to *Lonicera* are still not well studied. Specimens stored in herbaria, along with analyses, demonstrate that the genus *Lonicera* is widely distributed in the Tien Shan and Pamir-Alay mountains. The species can also be found in zones ranging from foothills (700–800 m) up to humid mountains (2400–3200 m). The only limiting factor in its distribution may be the low temperatures in the temperate highlands.

The present study provides comprehensive information on the diversity, distribution, nativity, endemism, and status of 10 *Lonicera* species in the Flora of Uzbekistan. Among them, one are no national endemics; four species are endemic to the Mountainous Middle Asia. A dichotomous key for species identification and the geographical distribution of all *Lonicera* species in Uzbekistan have been mapped in GIS. Use of the geographic locations of the collection sites, combined with GIS software, allowed the prediction of distribution and the estimation of species richness for the genus *Lonicera* in Uzbekistan. Species distribution maps based on GIS

using data from the last century can provide valuable insights into where species (populations) may disappear due to anthropogenic impacts and are important for species conservation.

Acknowledgements

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