



## *Salvia insignis* Kudr. (Lamiaceae): current status, rarity, and prospects for conservation *in situ*

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### ABSTRACT

*Salvia insignis* Kudr. is a rare and locally restricted endemic growing on the Babatag Ridge of southern Uzbekistan and Tajikistan at 600 to 1100 m a.s.l. It is a typical element of the flora of variegated outcrops of mountainous Middle Asia. Described in 1937 from collections made in 1887, it was then reported as present in several localities, but only with very few occurrences. Despite later expeditions, no further collections of herbarium specimens were made from those sites mentioned in the literature, most likely due to human-induced landscape alterations. The obtained new data on the distribution and morphology of this species will allow for new strategies for its protection *in situ* and preservation of its gene pool *ex situ*.

**Keywords:** rare plant species, endangered species, Middle Asian endemic, chorology, morphological traits, holotype, flora of variegated outcrops, Babatag, Tajikistan, Uzbekistan

### РЕЗЮМЕ

**Байкова Е.В., Турдибоев О.А., Пулатов С., Мадаминов Ф., Байков К.С., Шелудякова М.Б. *Salvia insignis* Kudr. (Lamiaceae): текущий статус, редкость и перспективы сохранения *in situ*.** *Salvia insignis* Kudr. – редкий вид, локальный эндемик, произрастающий на хребте Бабатаг на юге Узбекистана и Таджикистана, на высоте от 600 до 1100 м над ур. моря. Вид является элементом специфической, оригинальной флоры пестроцветных обнажений, характерной для горной Средней Азии. Описанный в 1937 году по сборам 1887 года, он был отмечен в нескольких местонахождениях и встречался очень редко. С тех пор, несмотря на поиски ботаников, сборов гербарных образцов из мест, упомянутых в литературе, не было, скорее всего, из-за сильных антропогенных изменений ландшафта. Полученные новые данные по распространению и морфологии этого вида позволяют разработать стратегии его охраны *in situ* и сохранения генофонда *ex situ*.

**Ключевые слова:** редкие виды растений, исчезающие виды, эндемики Средней Азии, морфологические признаки, хорология, голотип, Бабатаг, Таджикистан, Узбекистан

Plant extinctions are becoming more and more significant as a result of the global biodiversity extinction crisis. Caveats can be alleviated through increased study in poorly known biodiverse areas, and by deepening our understanding of the environmental, socioeconomic and temporal relationships between possible extinction and rediscovery. It is especially important to compile data on the efforts of botanists to investigate, species density, abundance and detectability, as well as to engage local people in the search for undiscovered biodiversity. Such efforts will improve our understanding of genuine extinctions and help target future conservation efforts (Humphreys et al. 2019).

The genus *Salvia* L. is represented in Middle Asia by 35 species (Khassanov et al. 2015), among which many are rare and endemic to this region (Makhmedov 1984, Zhogoleva & Kochkareva 1986, Turginov et al. 2019, Turdiboev 2020, Turdiboev & Turginov 2021, Turdiboev et al. 2022). Some of the species have been thoroughly investigated recently (Shomurodov et al. 2017), but in general, rare and endemic species of sage in Middle Asia remain poorly studied to this day. Endemic species have a high conservation priority, as

they are exclusive to a geographically restricted and limited area. Being often rare and ecologically specialized, any unfavorable change can cause their rapid extinction (Callmander et al. 2008).

*Salvia insignis* Kudr. is an extremely rare Middle Asian endemic species considered as a strict endemic for the Pamir-Alay (Babatag Ridge) (Kudrjashev 1937, Vvedensky 1961, Pobedimova 1954, 1977, Makhmedov 1980, 1984, 1987). The Babatag Ridge is located at the boundary of Uzbekistan (Surkhandarya region) and Tajikistan (Districts of Republican Subordination and Khatlon Region). There are 63 endemic species growing in the Surkhandarya region, according to the recently published “Endemic plant species richness of Surkhandarya province, Uzbekistan” (Tojibaev et al. 2022).

*Salvia insignis* was described in 1937 by S.N. Kudrjashev based on herbarium specimens collected by S.I. Korshinsky in 1887 from the eastern slopes of the Babatag mountain ridge of the Pamir-Alay. According to Makhmedov (1984), its occurrence is extremely limited and in a critical state. Special protection of the species is urgently required. Since 1984,

the plant has been listed in the Red Data Book of Uzbekistan as critically endangered (Khassanov 2019) and has also been added to the Red Data Book of Tajikistan (Rahimi et al. 2017). This species is also listed in the recently published “Illustrated flora of Tajikistan and adjacent areas” (Nowak et al. 2020), however there is still little data about it. Data on *S. insignis* in GBIF (2022), POWO (2022), COL (2022), WCVP (2022) databases are extremely scarce, its specimens are absent in JSTOR (2022) and Virtual Herbaria (2022). It is therefore necessary to identify the current range of this species.

The morphological diagnosis of the species was given in Latin and Russian when describing the species by Kudrjashev (1937). It was subsequently expanded and detailed by Pobedimova (1954). It is necessary to modify the description of *S. baldshuanica* on the basis of modern morphological approaches and terminology regarding the type of synflorescence and the division of shoots into structural and functional zones. It is also necessary to correct the description taking into account the morphological parameters of the plants we have recently found.

This work is carried out as an extension of previous studies of rare and endemic Middle Asian species of the Lamiaceae family within the framework of the long-term international cooperation of the Central Siberian Botanical Garden SB RAS with research institutes of Uzbekistan and Tajikistan (Astashenkov et al. 2021, Cheryomushkina et al. 2021, Turdiboev et al. 2021). This paper reports on the current state of studies on the rare and endangered species *S. insignis* from herbarium materials and in natural habitats to identify its modern range and clarify its morphological features, as well as to assess its current distribution, the degree of rarity, and prospects for conservation *in situ*.

## MATERIAL AND METHODS

The distribution of *S. insignis* Kudr. has been assessed in several ways, including analysis of herbarium collections of LE, TAD, TASH (acronyms according to Thiers (2022)), literature data, and through field studies (from 2020 to 2021). To map the distribution, all sites of the species in the field were geo-referenced and the coordinates archived via GIS. The specimens are kept at the Herbarium of the Komarov Botanical Institute (LE), the Botanical Institute of the Tajikistan Academy of Sciences (TAD), and the National Herbarium of Uzbekistan (TASH).

## RESULTS AND DISCUSSION

***Salvia insignis* Kudr.** – Trudy Sektora Rast. Res. Komit. Nauk Uzbeksk. SSR 3: 19 (1937).

**Holotype:** TAJIKISTAN. Buchara, Kabadansky [Qabodiyon] bekstvo: in decliviis lapidosis montium Babatagh, 12 V 1887, fl. et fr. S. Korschinsky 4167 (LE00051705!, excl. [uding] Korschinsky 552) (Fig. 1).

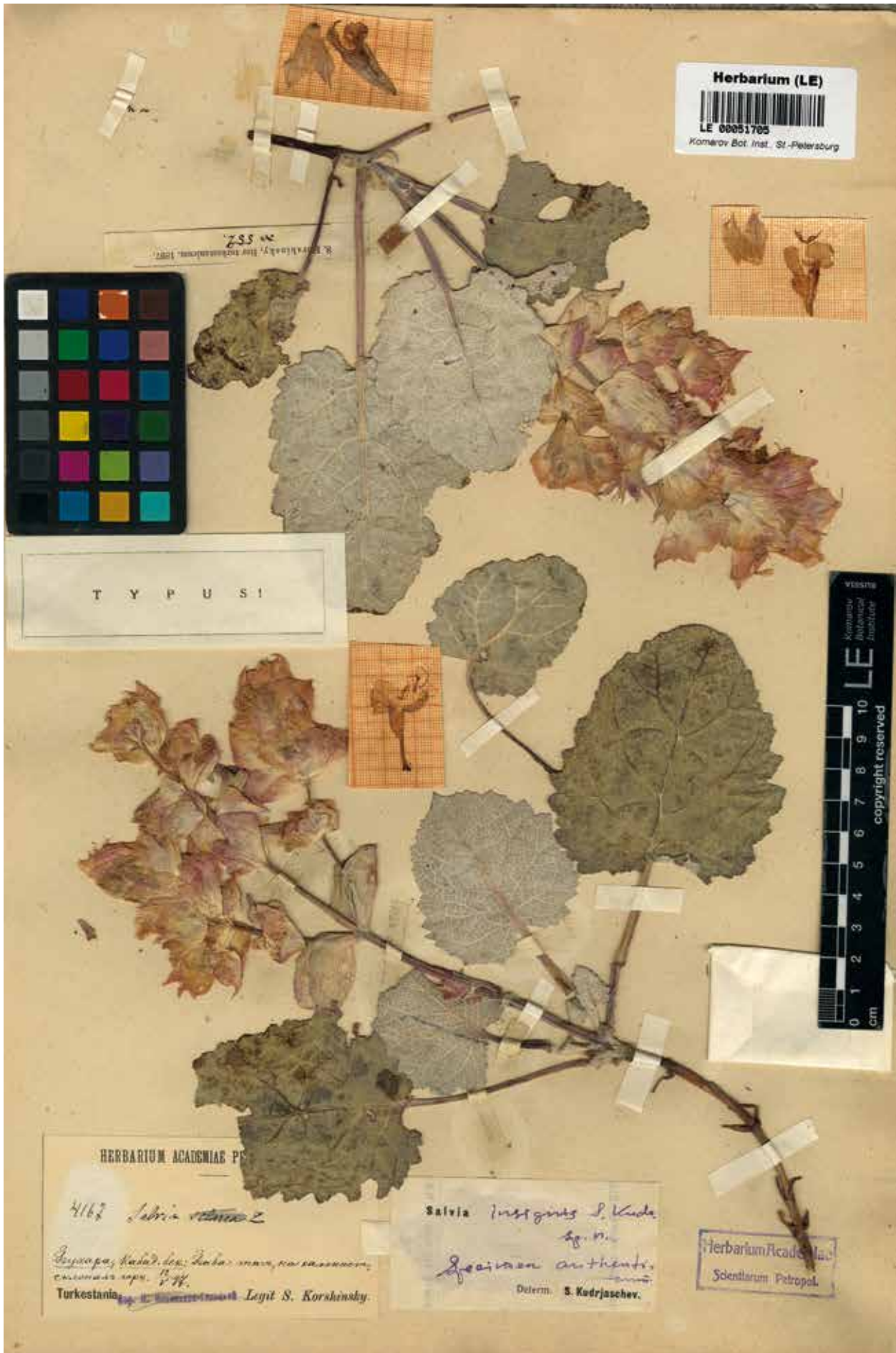
**Notes:** S.N. Kudrjashev (1937) describing this species mentioned type citation: “Montes Sogdiano-transoxanae. In decliviis lapidosis montium Baba-tagh. 12 V 1887. fl. et fr. Legit S. Korschinsky. (n. 4167). Type stored in LE”. During the revision, it was found that the type specimen designated by Kudrjashev consists of two plants mounted on a single herbarium sheet labeled under number 4167. As both individuals are mounted on a single herbarium sheet

and have a single herbarium label (below, left, no. 4167; not the unknown etiquette number 552), they must be regarded as a single herbarium sheet representing the type material. The type material may include more than one individual mounted on a single herbarium sheet (Turland et al., 2018; Art. 8.2). According to V. Lipsky (1905), the small etiquette (number 552) could be the field number of the gathering.

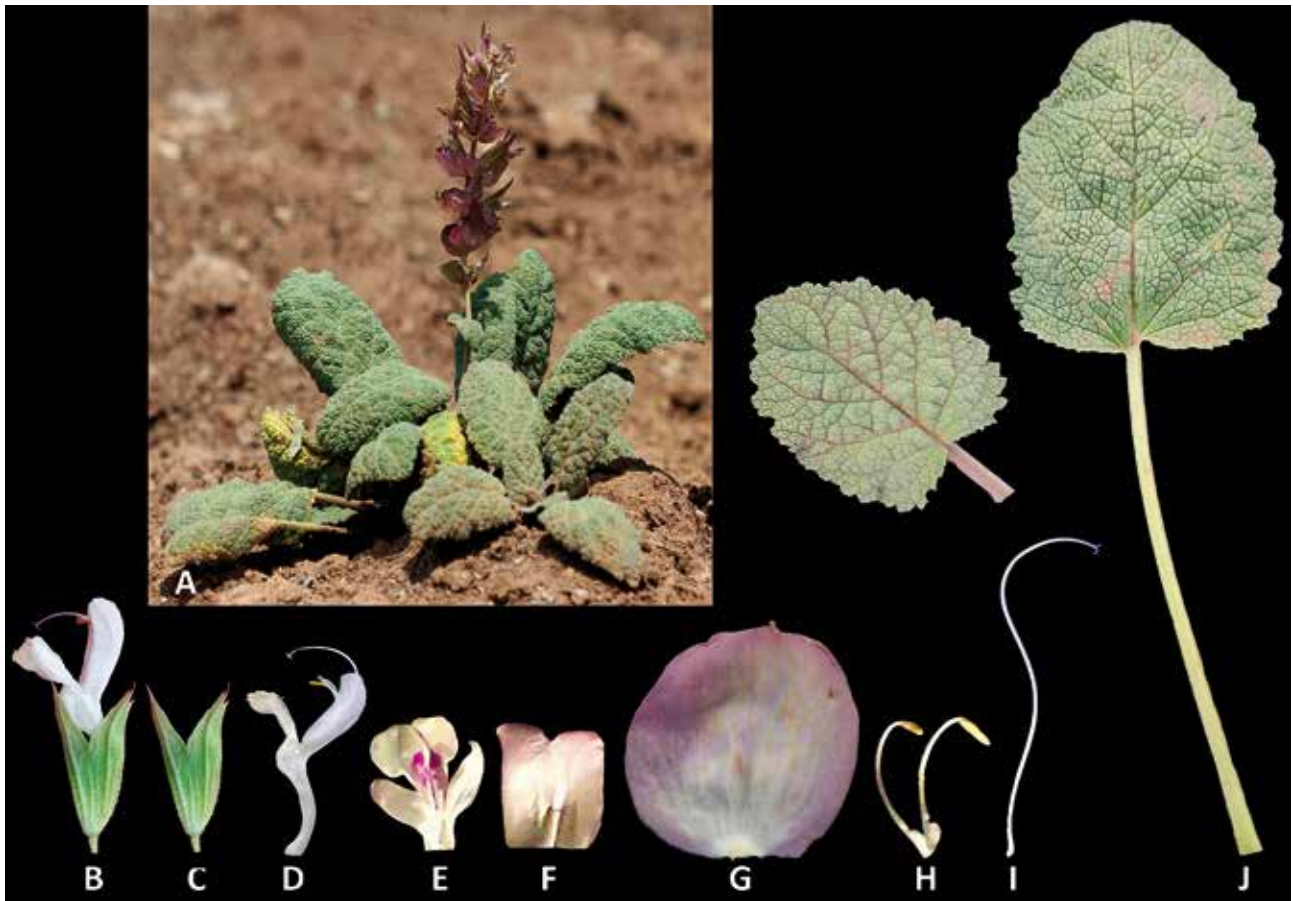
**Other specimens examined:** TAJIKISTAN. Babatag Ridge, surroundings of Khodja-Milk. 23.V.1906, Roshevits, 759 (LE); surroundings of Umar [Umbar]. 18.V.1906, Morren, s.n. (LE, not seen). UZBEKISTAN. Babatag Ridge. Bile-imas pass. 3.V.1940, Bukasov, s.n. (TASH); Western slopes of Besharcha mountains. On from the village of Lyalmikor. Neighborhood relatives Garmabulak. 18.V.1979, Tsukervanik, Lee, 294 (TASH); 40 km to the E from the village of Lyalmikor. Besharcha mountains. Neighborhood tract Kashka. 19.V.1979, Tsukervanik, Lee, 288 (TASH); Besharcha mountains, tract Kashka. 19.V.1979, Kamelin, Makhmedov, 293, 298 (LE, TASH, TAD); Besharcha mountains, tract Garmabulak. 19.V.1979, Kamelin, Makhmedov, 293 (LE); Surkhandarya region. Babatag ridge. Surroundings of the village of Akmachit. 20.IV.2021, Turginov, Turdiboev, Pulatov, 7,8,9,10 (TASH); Surkhandarya region. Babatag ridge. Surroundings of the village of Chagam. 4.V.2021, Turdiboev, Pulatov, Akbarov, 10, 12 (TASH); Surkhandarya Region. Babatag Ridge. Khazratibobo. 5.VI.2022, Pulatov, Makhmudjonov, 87 (TASH).

**Morphological description.** Perennial, 20–25 cm high, with a long slender ascending or subvertical underground base of shoot (rhizome) apparently extending from a contractile taproot deeply embedded in the substrate; rhizome about 0.5 cm in diameter, with pairs of scaly leaves at the nodes and without adventitious roots; stem solitary, short, as long as or slightly longer than the inflorescence, sparingly tomentose with a lining of short stipitate glands, in inflorescence also with short thick bristly retrorse hairs, in upper part of inflorescence and on branches mainly with long-stipitate glands. Leaves predominantly condensed in a basal rosette (Fig. 2 A), broad-ovate to suborbicular or elliptical (Fig. 2 J), 8–10(12) cm long, 6.5–9.5 cm broad, obtuse or half-rounded at apex, cordate at base, with crenate margin, covered beneath with short tomentum and scattered sessile glands, sparsely puberulent or subglabrous above, long-petioled, the petiole 9–14 cm, longer than blade, white-tomentose; upper leaves smaller; leaves subtending inflorescence scarious, sessile, broad-elliptical, short-pointed, whitish-green, with sparse short pubescence beneath mainly on the veins; floral leaves (bracts) (Fig. 2 G) broad-ovate, exceeding the calyx and often covering the corolla, short-pointed, sessile, clasping, scarious, pinkish, covered beneath with short crisp hairs. Synflorescence is double thyrsus with condensed spicate floral units (Baikova 2006) and 1 or rarely 2 pairs of partial florescences not exceeding the main florescence; pairs of cymes (so-called “verticillasters”) closed, 1–1.5(2) cm apart and even less, 2–4-flowered, 2 flowers often abortive. Calyx campanulate (Fig. 2 C), 1.5–2 cm long in flowering, funnel-shaped expanded to 2.5–3 cm in fruiting, covered outside with short thick multicellular pointed hairs intermixed with short-stipitate glands mainly on the veins, sparsely puberulent inside, sometimes lilac, bilabiate nearly to the middle; upper calyx-lip longer than the lower, with connivent teeth, the middle tooth half the length of the lateral teeth; lower up with 2 longer finely pointed glandular-pubescent teeth. Corolla (Fig. 2 D) white (revealed recently) rarely pink, the tube completely included, with a small bundle of hairs in throat; upper lip of corolla short, about equaling the lower, slightly curved,

**Figure 1** Holotype of *Salvia insignis* Kudr. (LE00051705 [photo])







**Figure 2** Morphological structures and habit of *Salvia insignis*: habit (A), flower (B), calyx (C), corolla (D), corolla lower lip (E), corolla upper lip (F), bract (G), stamens (H), pistil (I), leaves (J)

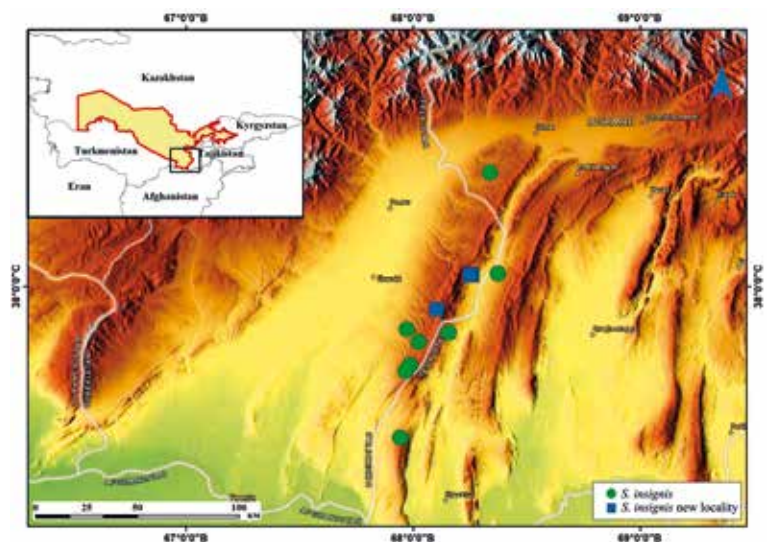
suberect, puberulent outside, with scattered sessile glands; lower lip (Fig. 2 E) with elliptical strict lateral lobes, the broadly obovate middle lobe scarcely concave, emarginate, with unevenly and obtusely toothed margin. Stamens (Fig. 2 H) exerted; sterile anther-locules rectangular, scarious, scarcely notched at middle; upper stamens reduced to short staminodes with very small arched sterile anthers. Style violet, exerted; stigma more intensely colored, with subequal lobes (Fig. 2 I). Nutlets ellipsoid, faintly trigonous, 3.5 mm long, greenish with brown reticulation.

**Habitat and ecology.** *Salvia insignis* grows on variegated outcrops of limestone and screes of stony mountain slopes in the lower zone of the mountains. Its altitudinal range extends from 600 to 1100 m. Other species growing in the area are *Salvia spinosa* L., *Salvia bucharica* Popov, *Allium giganteum* Regel, *Astragalus bucharicus* Regel, *Centaurea belangeriana* (DC.) Stapf, *Convolvulus arvensis* L., *Avena fatua* L., *Lallemantia royleana* (Benth.) Benth., *Ziziphora tenuior* L., *Lagochilus botschantzevii* Kamelin & Tzukerv., *Cleome* sp. and *Ephedra* sp. Most of them are endemics for Pamir-Alay and specific for variegated outcrops. The flora of variegated outcrops is characterized by exceptional endemism. This is a peculiar, but typical mountainous flora of the southern strip of the Old World warm-temperate floras on their contact with subtropical floras (Kamelin 2017).

**Phenology.** Flowering occurs in late April and fruiting from May to June.

**Distribution.** *Salvia insignis* is endemic to southern Uzbekistan and Tajikistan (Babatag Ridge)

(Fig. 3). According to Makhmedov (1980), it is known from an area of variegated outcrops of southern Babatag, in the vicinity of the Garmabulak, Kashka, and Biyas-imas springs (Uzbekistan) and from the vicinity of the Ukhlov and Anybulak springs (Tajikistan), where it grows in open communities on the products of disintegrating gypsum-bearing serozemic clays with large fossilized shells of mollusks. The total number of individuals in the thickets, apparently, does not exceed one thousand.



**Figure 3** Current distribution of *Salvia insignis* in Uzbekistan and Tajikistan according to the revision of the LE, TAD, and TASH herbaria

There are no herbarium collections from the last 40 years (since 1979). Our research carried out in 2021–2022 in the Babatag Ridge area of Surkhandarya, allowed us to ascertain three new localities at about 25–30 km distance from those previously reported in the literature (Figs 3, 4). The small isolated population with about 15–20 plants was growing on variegated outcrops at altitudes from 600 to 1500 m a.s.l. (Fig. 4).

The plants' habitat is being destroyed by driving livestock and other economic activities. Thus, *S. insignis* can be considered to be seriously threatened, facing an immediate high risk of extinction.

**Related species.** *Salvia insignis* is closely related to *S. seravshanica* Regel & Schmalh., differing by leaves bare green above, white-tomentose-pubescent below, and not stified on both sides, 2–4-flowered nodules (Fig. 2). It clearly differs from *S. sclarea* L. by a whole range of features: short stature, a different shape of the calyx, bracts, corolla, leaf shape, etc.

## CONCLUSION

The extremely rare endemic *S. insignis* requires immediate conservation priority since the disappearance of its local populations may cause the extinction of this species. It needs to become the subject of specific *in situ* and *ex situ* conservation efforts. Local authorities involved in the conservation of natural resources and the should take action to protect of this species.

Plants of *S. insignis* are currently being cultivated and studied at the Tashkent Botanical Gardens, leading the way to preserving the gene pool *ex situ* and for possible repatriation measures to natural habitats in the future.

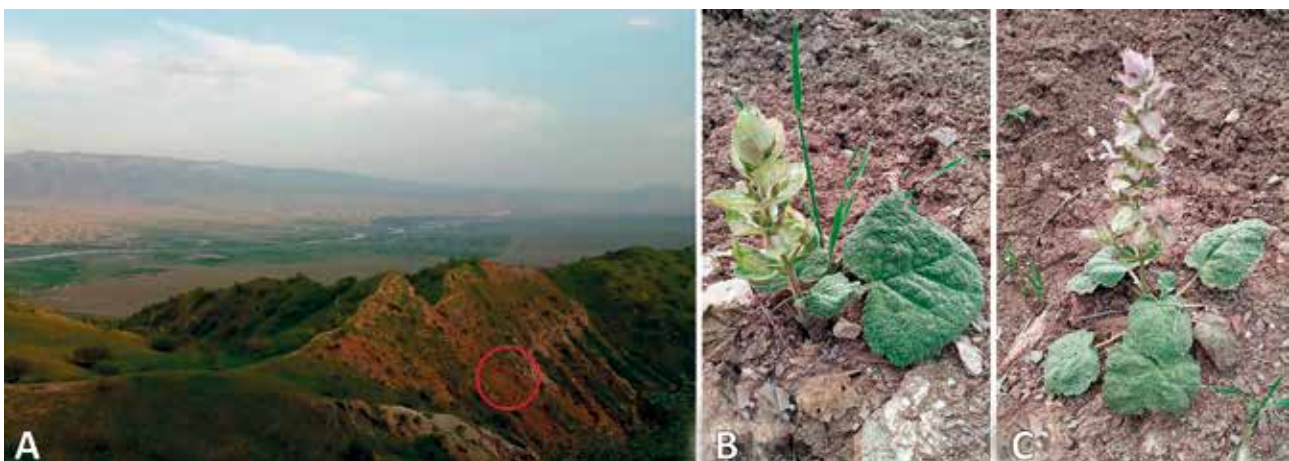
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(AAAA-A18-118022090078-2). The authors are grateful to the curators of LE, TAD, TASH for providing access to the herbarium material, to I. Mehregan (Iran), S. Bandyopadhyay, and A. Kumar (India) for comments regarding the application of ICN and providing further literature and suggestions, and the authors thank Prof. Furkat Khassanov (National Herbarium of Uzbekistan, TASH, Tashkent, Uzbekistan) for valuable comments and suggestions. We express our thanks to T.C.H. Cole for English language editing and valuable comments.

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**Figure 4** New locality and habitat (A) of *Salvia insignis* (B, C)



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