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RESEARCH ARTICLE

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Global and Regional IUCN Red List Assessments: 17

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Abstract

In this contribution, the conservation status assessment of three vascular plants according to IUCN categories and criteria are presented. It includes the assessment of *Campanula bergomensis* F. Mangili & L. Mangili, *Iris hippolyti* (Vved.) Kamelin and *Stipa aktauensis* Roshev. at global level.

Keywords

Conservation, extinction risk, IUCN protocol, threats

How to contribute

The text of the global and regional assessments should be submitted electronically to Simone Orsenigo (simone.orsenigo@unipv.it) or to Giuseppe Fenu (gfenu@unica.it); the text, up to 8000 characters in length (spaces included), must include a distribution map and a picture of the assessed species.

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Red List Assessments

Campanula bergomensis F. Mangili & L. Mangili

Global assessment
Taxonomy and nomenclature
Order: Asterales *Family*: Campanulaceae

Campanula bergomensis F. Mangili & L. Mangili, Phytotaxa 637(2): 120–132 (2024)

Common name: Campanula bergamasca (It).

Geographic distribution range: *Campanula bergomensis* (Fig. 1) is a perennial species occurring only in the eastern Bergamo Prealps (sensu Marazzi 2005; Italy, Lombardy, district of Bergamo), in a few areas (Fig. 2). Most populations are located in small valleys close to the village of Clusone (BG), mainly in the Borlezza hydrogeographic basin (e.g., Val di Tede, Val di Frucc, Val dei Dadi, Val Romentareck; Valle et al. 2024). Other isolated records are reported from Valcanale, Val Nossana (Serio basin), and Val Conchetta (Dezzo basin; Valle et al. 2024).

Distribution: *Countries of occurrence*: Italy.

Biology: *Plant growth form*: perennial (hemicryptophyte).



Figure 1. *Campanula bergomensis* from Valle dei Dadi (BG). Photograph by Luca Mangili.

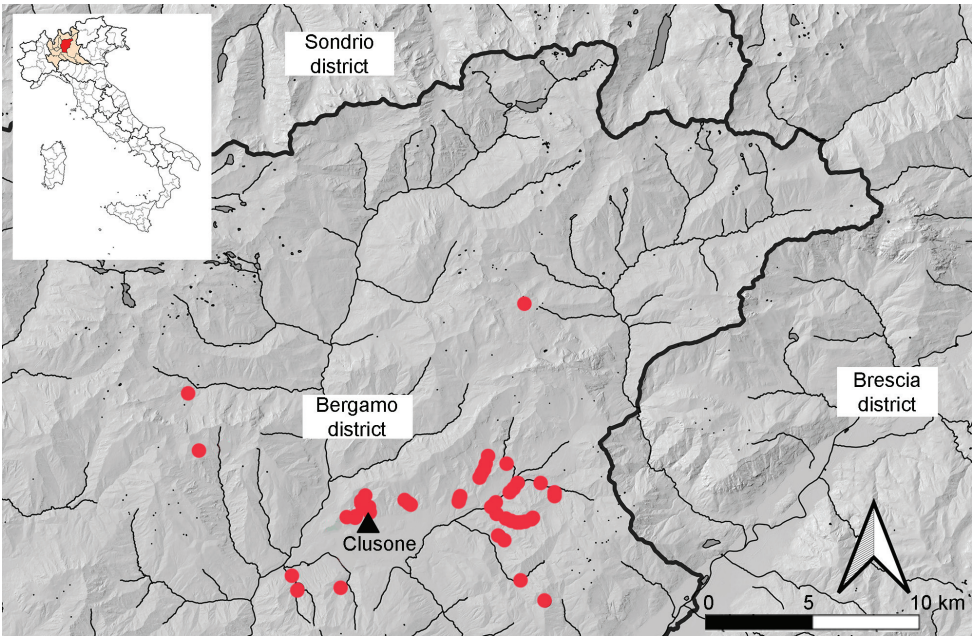


Figure 2. Distribution map of *Campanula bergomensis* in the Bergamo Prealps. In the box, position of Bergamo district with respect to the administrative region of Lombardia and to Italy.

Flowering and fruiting time: From mid-July to mid-August.

Reproduction: No information on dispersal strategy, pollination and seed germination is available. Preliminary experiments performed at Città Studi Botanical Garden (Milan) seem to indicate low germination rates (Valle et al. 2024).

Habitat and ecology: *Campanula bergomensis* grows on dolomitic debris cones, generally on poorly developed and well-drained soils, from 450 to 1.250 m a.s.l. The species is particularly associated with wide and flat debris cones, an unusual geomorphological feature in the Lombardy Prealps. *Campanula bergomensis* can be found on the edge of sparsely vegetated slopes with *Pinus mugo* Turra-dominated vegetation (with *Amelanchier ovalis* Medik., *Sesleria coerulea* (L.) Ard., *Calamagrostis varia* (Schrad.) Host, *Hieracium* sp., *Dryas octopetala* L., *Globularia cordifolia* L.). *Campanula bergomensis* shows a S-R strategy *sensu* Grime (Valle et al. 2024).

Population information: There is no detailed information available on population dynamics. Field observations indicate some stable subpopulations. Given the recent description of the species, the search for new populations is still ongoing. All observations known to date are reported in the digital atlas of Gruppo Flora Alpina Bergamasca (app.floralpinabergamasca.net), which covers the districts of Bergamo, Brescia, Sondrio, and Lecco. With the exception of one observation in Val d'Ancogno in 1999 (Luca Mangili, ex verbis), where the species has not been observed recently, the species is known with several subpopulations at all stations indicated in the digital atlas.

Threats:

6.1. Recreational activities: some populations include individuals growing on trails used by motocross and mountain bike and are currently threatened by human trampling.

7.3 Natural system modifications. (*Other ecosystem modifications*): debris cones where the species grows, when stabilized, are subject to colonization by shrub and tree species, resulting in habitat modification that leads to the disappearance of the species.

10.3 Geological events. (*Avalanches/landslides*): the debris cones where the species grows are located at the base of dolomitic cliffs, which are often unstable and subject to continuous erosion. In the event of landslides or collapse due to erosive processes, the disappearance of populations located nearby may occur.

11. Climate change & severe weather (*11.1 Habitat shifting & alteration*; *11.2 Droughts*; *11.3 Temperature extremes*): a potential threat in the future is constituted by the increasing number of drought periods and extreme meteorological events.

CRITERIA APPLIED

Criterion B: **EOO**: 100 km^2 calculated with sRedList (2023) with minimum convex polygon.
AOO: 64 km^2 calculated with a 2×2 km cell fixed grid.

a) No severely fragmented.
b) No continuous decline observed or estimated.

Red List category and Criteria (Global Assessment)

NT	**Near Threatened**	

Rationale for the assessment: *C. bergomensis* is an endemic species of a small portion of the Bergamo Prealps, whose populations are concentrated in the side valleys of Val Borlezza, on a few debris cones. In most of the known stations, it occurs, however, with a good number of individuals. Isolated individuals, on the other hand, have been found in Val Seriana (Val Nossana, Val Flex), and on the northern slope of Presolana (Val Conchetta). If not adequately monitored, the main populations in Val Borlezza, given the particularity of the debris cones on which they grow, can be severely damaged by the presence of bikers and motorbikers, which is very high in the area, and by erosive processes during heavy rains, which are accentuated in this phase of climatic warming. Despite the reduced AOO and the presence of some threats in some populations, continuous decline has not been observed. However, considering the peculiar ecology and the fact that the abovementioned threats, especially those related to the natural evolution of the debris cones vegetation and to recreational activities, could increase in the near future, and adopting the precautionary approach suggested by the IUCN guidelines, this species could be assessed as NT at the global level, on the understanding that if the predicted threats will actually affect populations, it would qualify as EN due to the small AOO.

Previous assessment: The taxon has never been evaluated (IUCN 2024).

Conservation actions: *C. bergomensis* is currently not protected by international, national or regional laws and no conservation measures for this species are applied. Some populations of *C. bergomensis* grow within a protected area of the Natura 2000 Network. In particular, the Val Nossana population is included in the Special Area of Conservation (SAC) "Val Nossana—Cima di Grem" (IT2060009); populations of Val Bielone, Romentareck, Val dei Mulini (Colle di Passeraia), and Monte Simer fall within the SAC "Val Sedornia, Valzurio, e Pizzo della Presolana" (IT2060005).

Conservation actions needed: Given the very recent description of the species, it is essential to acquire more information on its range, reproductive biology, and ecology in order to plan appropriate *in situ* and *ex situ* conservation actions. Essential, given the uniqueness of the species, is also the adjustment of the current legislation, with the inclusion of the species in the protection lists of the Lombardy Region (LR 31/2008), to prevent with greater force human activities in the area in which the species occurs.

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Barbara Valle, Federico Mangili, Marco Caccianiga

Iris hippolyti (Vved.) Kamelin

Global assessment
Taxonomy and nomenclature
Order: Asparagales *Family*: Iridaceae

Iris hippolyti (Vved.) Kamelin, A.L.Takhtadzhyan (ed.), Redkie Izchez. Vidy Fl. SSSR, ed. 2: 102 (1981)

Common name: Hippolyti's Iris (En).

Geographic distribution range: *Iris hippolyti* (Fig. 3) is a rare endemic plant of Uzbekistan. It grows on gray-brown desert soils of the remnant low mountains, Kokchatau and Karatau, situated in the eastern region of the Kyzylkum Desert, one of the largest deserts in Central Asia. The geographic extent of these isolated hills covers approximately 2.5 km², with a maximum elevation of 447 m a.s.l. (Shomurodov 2018; Shomurodov et al. 2021; Sennikov et al. 2023). The species is distributed in the northeastern area of Bukhara region and in the eastern area of Navoi region. The site in Kokchatau is located near the village of Zafarabad, the site in Karatau is located in the Kara-Karga mountain pass area (Fig. 4).



Figure 3. *Iris hippolyti* (Vved.) Kamelin from Kokchatau low mountain (Uzbekistan, Bukhara region). Photograph by Khabibullo F. Shomurodov.

Distribution: *Countries of occurrence*: Uzbekistan.

Biology: *Plant growth form*: perennial (geophyte).

Flowering and fruiting time: flowering in April and fruiting in May (Vvedensky 1941; Sennikov et al. 2023).

Reproduction: Literature sources do not provide enough information about reproduction.

Habitat and Ecology: *I. hippolyti* is a perennial, early-growing, grass-like bulbous ephemeroid characterized by rosette-shaped vertical shoots. In its natural environment, vegetative growth typically starts from mid-February to early March (Shomurodov 2018; Shomurodov et al. 2021). Its habitat is characterized by sparse vegetation and rugged terrain, consisting mainly of scattered rocks and gravel with limited soil cover. Vegetation, where present, is highly adapted to the harsh, dry conditions, showcasing drought-resistant features. This type of environment is challenging for flora due to the minimal water availability and extreme temperature fluctuations between day and night, typical of desert ecosystems.

Population information: Until 2018, *I. hippolyti* was known to have only one local population in Kokchatau. This population occupies an area of approximately 2–3 hectares, forming part of a mixed herb-*Artemisia-Zygophyllum* dominated plant community. In 2015, an estimated 300 individuals were recorded, in the 2020, the population had declined to 138 individuals (Tojibaev et al. 2020). In 2022, during

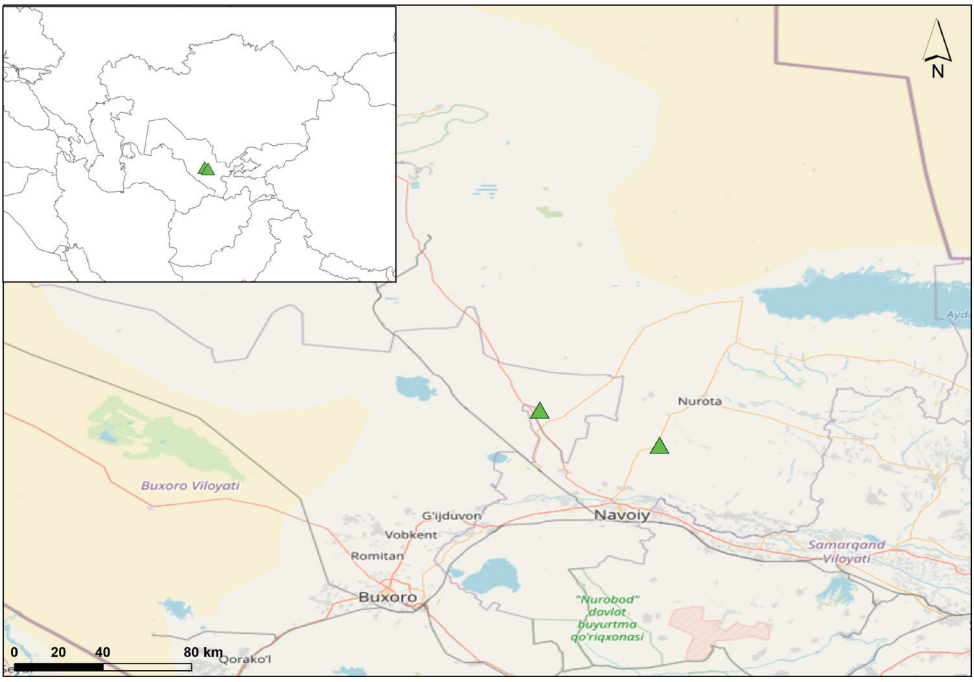


Figure 4. Geographic range and distribution map of *Iris hippolyti* in Kyzylkum remnant low mountains (Uzbekistan).

field research in the Karatau Mountains of eastern Kyzylkum, K. Tojibaev identified a new subpopulation of the species. The herbarium specimen collected by him from this area is stored in the TASH herbarium. This local population is confined to a very narrow range, with fewer than 40 individuals. *I. hippolyti* is not dominant in any of the phytocoenoses where it occurs.

Threats:

1.3 Residential & commercial development (*Tourism & recreation areas*): the sites where the plants are scattered correspond to the area where local people gather for hiking and outdoor activities (Shomurodov 2018; Shomurodov et al. 2021). Satellite images show that the mine workers living in the settlement of Zafarabad destroyed more than 2000 m^2 of *I. hippolyti*'s habitat for recreational activities.

2.3 Livestock farming & ranching (*2.3.1 Nomadic grazing* and *2.3.2 Small-holder grazing, ranching or farming*): Livestock farming is the main source of income for the residents of Kyzylkum. The main risk factor for almost all species from these territories listed in the National Red Book of the Republic of Uzbekistan is grazing. Persistent livestock grazing exerts one of the most harmful impacts on the population, contributing to habitat degradation and population decline (Shomurodov and Khabibullaev 2022).

11 Climate change & severe weather (*11.2 Drought*, *11.3 Temperature extremes*): *I. hippolyti* grows in the regions (Bukhara and Navoi) most affected by global climate change in Uzbekistan (Khabibullaev et al. 2022). A threat for the species is represented

by climatic anomalies, namely ground freezing at the end of February. The vegetative phase of *I. hippolyti* begins relatively early, typically in late February or early March. However, approximately once every 5–6 years, the region experiences severe frost events, which result in significant mortality among the juvenile plants (Khaitov 2024).

CRITERIA APPLIED:

Criterion A: the population experienced an observed decline of 54% in the number of individuals over the last 10 years.

Criterion B: **EOO**: 8 km^2 calculated with a GeoCAT (Geospatial Conservation Assessment Tool) software (Bachman et al. 2011).
AOO: 8 km^2 calculated with GeoCAT software and based on user defined cell width (2 km) (Bachman et al. 2011).

a) Two locations based on the main threats (*Nomadic grazing* and *Tourism & recreation areas*).
b) Observed continuing decline in extent and quality of habitat (iii) and number of mature individuals (v).

Criterion D: The global population, consisting of a total of 175 individuals, is currently experiencing a continuous decline in number of mature individuals.

Red List category and Criteria (Global Assessment)

EN	**Endangered**	**B1b(iii, v)+2b(iii, v) + D**

Rationale for the assessment: *I. hippolyti* is a species endemic to the remnant low mountains of the Kyzylkum Desert, with an extremely limited distribution, comprising only two known subpopulations. Despite supporting the largest number of individuals, the Kokchatau population has been experiencing a gradual decline. Anthropogenic pressures, both direct and indirect, continue to pose the most significant threat to the survival and stability of this species. The current status of the species' subpopulations is critical, with dangerously low numbers of individuals. The small EOO and AOO, the reduced population size and the observed decline in the number of mature individuals, according to criteria B and D, support the risk category of Endangered (EN) at a global scale for this species.

Previous assessment: The taxon is not evaluated at the global level (IUCN 2024).

Conservation actions: *I. hippolyti*, as a rare and endemic species, has been classified as Category 1 (Critically Endangered) in the National Red Book of the Republic of Uzbekistan, indicating its status as being on the brink of extinction (Khasanov et al. 2019). The species has been introduced into cultivation at the Tashkent Botanical Garden, and the reintroduction of individuals propagated under *ex-situ* conditions is deemed essential for its conservation. Furthermore, it is imperative to implement targeted conservation actions to ensure the survival of this species in its natural habitat.

Conservation actions needed: The effects of climate change are increasingly affecting biodiversity in Uzbekistan (Korolyuk at al. 2024). The *in-situ* conservation of *I. hippolyti* requires reinforcement. Additionally, *ex situ* conservation within protected areas presents a viable strategy. To support this approach, bioclimatic modeling of the species' potential distribution and the identification of regions that offer optimal ecological conditions are essential steps for effective conservation planning.

Khabibullo F. Shomurodov, Bekhruz Sh. Khabibullaev, Giuseppe Fenu

Stipa aktauensis Roshev.

Global assessment
Taxonomy and nomenclature
Order: Poales *Family*: Poaceae

Stipa aktauensis Roshev., Izv. Bot. Sada Akad. Nauk S.S.S.R. 30: 302 (1932)

Common name: Aktau's stipa (En).

Geographic distribution range: *Stipa aktauensis* (Fig. 5) is a rare endemic of the Kyzylkum remnant mountains, from the Poaceae family (Shomurodov 2018). It grows on dry, gravelly slopes and rock cracks of the remnant low mountains – Kuldzhuktau, Auminzatau, Bukantau, Tamditau, Muruntau, Aktau, and Sultan-Uizdag of the Kyzylkum Desert. Plant distributed mainly on the southern, western, and eastern slopes of the remnant mountains in sparse and scattered populations at altitudes from 400 to 700 m a.s.l. (Rakhimova et al. 2017; Fig. 6).

Distribution: *Countries of occurrence*: Uzbekistan.

Biology: *Plant growth form*: perennial (hemicryptophyte).

Flowering and fruiting time: flowering and fruiting in April-May (Drobov 1941), fruiting sometimes lasts until June (Rakhimova et al. 2017; Shomurodov 2018).

Reproduction: Existing literature lacks sufficient information on reproduction.

Habitat and ecology: *Stipa aktauensis* is a perennial herbaceous plant with a dense tussock form, reaching a height of 25–30 cm and lives up to 30 years. The remnant mountain's terrain is often barren and dry, with coarse gravel and rock-strewn surfaces shaped by erosion over centuries. In this harsh environment, where rain is infrequent, the rocks of the mountains are home to unique microhabitats, providing shelter for endemic plants like *S. aktauensis*. This plant thrives on the shallow soils that collect in cracks and crevices of the mountain rocks, surviving the extreme temperatures and arid conditions of the desert. The surrounding landscape is typically desolate, with a mix of low shrubs, sparse grasses, and wide, open spaces.

Population information: Historical literature lacks data regarding the local populations size or the total number of individuals of the species (Rodzhevits 1934; Drobov 1941; Paziy 1968)**.** Recent field studies have documented over 2,000 individuals of *S. aktauensis*. The population density varies across different regions, with higher



Figure 5. *Stipa aktauensis* Roshev from Kuldzhuktau (Uzbekistan, Navoi region). Photograph by Khabibullo F. Shomurodov.

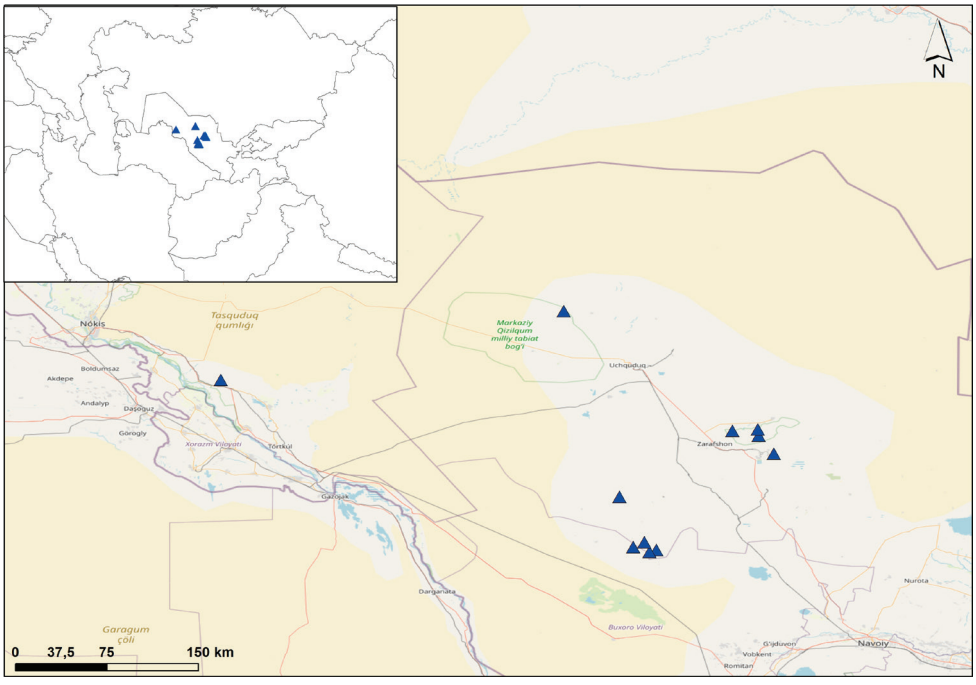


Figure 6. Geographic range and distribution map of *Stipa aktauensis* in Kyzylkum remnant low mountains (Uzbekistan).

concentrations in Kuldzhuktau, Tamditau, and especially Aktau, compared to Auminzatau, Bukantau, and Sultan-Uizdag. Specifically, approximately 600 individuals were recorded in Kuldzhuktau, more than 400 in Aktau, 400 in Tamditau, around 200 in Auminzatau, 150 in Muruntau, and 300 in Bukantau. Sultan-Uizdag exhibited the smallest population, with only about 80 individuals identified. In all populations, livestock grazing is causing a decline in the number of individuals. The population status of this species has been evaluated through comprehensive analysis of its communities (Rakhimova et al. 2017; Shomurodov 2018).

Threats:

2.3 Livestock farming & ranching (*2.3.1 Nomadic grazing* and *2.3.2 Small-holder grazing, ranching or farming*): Constant livestock grazing in the habitat of *S. aktauensis* is a threat by causing habitat degradation, reducing population density through direct consumption, and disrupting the species' ability to regenerate. Overgrazing also leads to soil erosion and shifts in plant community composition, making it harder for *S. aktauensis* to compete and thrive.

3 Energy production & mining (*3.1 Oil & gas drilling*, *3.2 Mining & quarrying*, *3.3 Renewable energy*): Several mines and energy-related activities are present at sites where *S. aktauensis* grows, leading to a progressive loss of habitat quality and individuals. The most active point of geological exploration in Kyzylkum is Kuldzhuktau, where the search for light metals (including gold), and marble is especially active today. In addition, the habitat of the species is being destroyed to build wind power stations there and in Tamditau. In Sultan-Uizdag, the proliferation of stone crushing equipment and the substantial increase in gravel production are severely impacting the local population, resulting in the lowest population size in this region.

CRITERIA APPLIED:

Criterion B: **EOO**: 32,725 km^2 calculated with a GeoCAT (Geospatial Conservation Assessment Tool) software (Bachman et al. 2011).
AOO: 44 km^2 calculated with GeoCAT software and based on user defined cell width (2 km; Bachman et al. 2011).

a) Five locations based on the main threat (*Nomadic grazing*).
b) Continuing decline, observed in extent of occurrence (i), area of occupancy (ii), extent and quality of habitat (iii), number of locations or subpopulations (iv), number of mature individuals (v).

Red List category and Criteria (Global Assessment)

EN	**Endangered**	**B2ab(i, ii, iii, iv, v)**

Rationale for the assessment: *Stipa aktauensis* is an endemic species that lacks territorial protection and is restricted to the remnant low mountain ranges of Kyzylkum. The vitality of the subpopulations was assessed as critical (Shomurodov 2018). Alongside other endemic species of the remnant mountains, *S. aktauensis* is experiencing a

rapid decline in populations year after year. Its restricted range to specific relict mountains further exacerbates its vulnerability. The species has an EOO of approximately 32,725 km² and an AOO of 44 km². Considering the small AOO, the continuous decline and the persistence of identified threats, which remain unmitigated, the condition of the populations is projected to deteriorate in the future. Therefore, according to criterion B, this species can be classified as Endangered (EN) at a global level.

Previous assessment: This species was not previously evaluated (IUCN 2024).

Conservation actions: *Stipa aktauensis* has been included in the National Red Book of the Republic of Uzbekistan in several categories from 1975 to the present (Khasanov et al. 2019). Attempts to cultivate it in the territory of the desert station in Kyzylkum were unsuccessful. At present, seeds of *S. aktauensis* are not conserved in any germplasm bank. It is crucial to raise international awareness of the critical status of rare species in Uzbekistan through collaborative projects or publications (e.g., Fenu et al. 2022, 2023) and to explore alternative solutions to address this pressing issue.

Conservation actions needed: Research and monitoring activities are recommended to improve understanding of the reproductive biology, ecology, threats, and population trends of the species, as well as to facilitate *ex-situ* conservation measures, including the establishment of a seed bank.

Giuseppe Fenu, Khabibullo F. Shomurodov, Bekhruz Sh. Khabibullaev

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