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Red list of the threatened vascular plants of Uzbekistan

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ABSTRACT

This study presents the results of a comprehensive reassessment of threatened vascular plant species included in the sixth edition of the Red Data Book of the Republic of Uzbekistan using the IUCN Red List Categories and Criteria. The assessment was based on targeted field surveys conducted during 2020–2025, combined with a critical analysis of herbarium records, taxonomic revisions, and published and unpublished floristic data. A total of 367 vascular plants were evaluated, including 314 species previously listed in the fifth edition of the Red Book and additional 53 candidate species. As a result, 317 taxa were included in the updated national Red Book, of which 207 are strict national endemics, and 92 are regional endemics of Central Asia. Twenty-four species were newly identified as threatened and recommended for inclusion, while 21 taxa were excluded due to taxonomic synonymization, wider-than-previously-assumed distribution ranges, or evidence of stable and recovering populations. According to IUCN categories, one species (*Dipcadi turkestanicum* Vved.) was assessed as Extinct (EX), 41 as Critically Endangered (CR), 168 as Endangered (EN), 56 as Vulnerable (VU), and 44 as Data Deficient (DD). More than half of threatened species (55%) occur entirely outside the current network of protected areas, with particularly low coverage in desert regions (Kyzylkum and Ustyurt Plateau) and in intensively transformed landscapes such as the Fergana Valley. These findings provide an evidence-based foundation for updating national conservation priorities, expanding protected area coverage in underrepresented regions, and aligning biodiversity conservation planning in Uzbekistan with international IUCN standards.

1. Introduction

Central Asia is one of the key global centers of biodiversity and one of the most important regions for the concentration of endemic vascular plant taxa (Myers et al., 2000; Ecosystem Profile, 2017). According to current estimates, the flora of this region comprises c. 9643 vascular taxa, 3409 of which are endemic to Central Asia. A significant proportion of this diversity is concentrated within the territory of the Republic of Uzbekistan, where about 4384 taxa of vascular plants occur, including 327 strict national endemics (Khassanov, 2015; Sennikov et al., 2016; Ma et al., 2024). The high rate of endemism, together with the spatial fragmentation of species' distribution ranges and increasing

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anthropogenic pressure, determines an exceptional vulnerability of the region's flora and underscores the priority of its conservation.

The conservation of biodiversity, including the endemic flora, is one of the key environmental priorities of the Republic of Uzbekistan, formalized through the ratification of the Convention on Biological Diversity (OMRU, 1995). In this context, the "*National Red Data Books*" and the "*IUCN Red List of Threatened Species*" are key tools for assessing species' extinction risk and, for planning scientifically based conservation measures. Their importance lies in the use of standardized, quantitatively measurable criteria which allow comparison of assessment results across regions and countries (e.g., Maes et al., 2015; Collen et al., 2016).

However, plant conservation still faces major gaps in fundamental knowledge, including data on taxonomy, distribution, ecology, population biology and demography, economic and ecological value, threat factors, and conservation status (Heywood, 2017). Species-level research and monitoring are therefore essential for generating the baseline data needed for effective biodiversity conservation (Fenu et al., 2020; Xu and Zang, 2023).

Experience from various countries and regions demonstrates that the regular updating of Red Lists based on targeted field surveys substantially improves the accuracy and effectiveness of conservation planning. Periodic reassessments incorporate newly discovered species, account for taxonomic revisions, refine species distribution data, detect changes in population status and extinction risk, and identify remaining knowledge gaps requiring further research. For example, successive updates of the European Red List of Vascular Plants have improved the accuracy of conservation assessments by integrating new taxonomic and distributional information, while also revealing that approximately 20% of Europe's vascular flora is threatened with extinction (Bilz et al., 2011). Similar reassessments at the national level have shown that 22.4% of the endemic flora of Italy (Orsenigo et al., 2018) and 22.1% of the endemic flora of Spain (Muñoz-Rodríguez et al., 2016) are threatened, values that are consistent with the global estimate of 22.0% for vascular plants (Brummitt et al., 2015). These examples demonstrate that regular Red List updates not only improve the accuracy of conservation assessments but also provide an evidence-based foundation for identifying conservation priorities and responding to changes in species status over time. In China, more than 10% of vascular plants are listed as threatened in the national Red List, with narrowly distributed strict national endemics contributing most substantially to this figure (Qin et al., 2017a; Xu and Zang, 2023). In total, of the 3879 threatened species, 614 are classified as Critically Endangered (CR), 1313 as Endangered (EN), and 1952 as Vulnerable (VU) (Qin et al., 2017b). Much more worrying values were obtained for Iran, where the percentage of threatened endemic species exceeds 75% (Khalvati et al., 2025).

In Central Asian countries, national lists of threatened species are also regularly updated. The latest edition of the Red Data Book of Kazakhstan (Baitulin, 2014) includes 387 vascular plants, 13 species of fungi, and one lichen, while the Red Data Book of the Republic of Tajikistan (Hisoriev, 2017) lists 267 plant species. The Red Data Book of the Kyrgyz Republic contains 83 species of vascular plants and four species of fungi (Davletkeldiev, 2006) and the Red Data Book of Turkmenistan includes 121 species of vascular plants (Saparmuradov, 2024). In all of the above editions, the total number of protected taxa has increased over time compared to previous versions.

The National Red Data Book of the Republic of Uzbekistan (RDBUz, hereafter), has been updated several times. The first edition (1984) included 163 vascular plants, while in the second one (1998) the number of protected species increased to 301, reflecting both the new data and the intensification of anthropogenic pressure on natural ecosystems. In the third edition, the total number of species remained almost unchanged (302) but nine species included in previous versions were excluded due to the discovery of additional local populations, whereas ten species, newly recognized as threatened, were added to the Red List. The most significant changes in the composition of threatened species occurred in the fourth edition, where 321 species were assessed as threatened. Based on the results of field studies conducted over eight years, 49 taxa were excluded from the list due to genuine increases in population size and expansion of their distribution ranges (e.g., *Crocus korolkowii* Maw & Regel, *Euonymus koopmannii* Lauche (= *Euonymus nanus* M. Bieb.), *Allium suworowii* Regel, *Allium stipitatum* Regel, etc.). At the same time, 71 new taxa recognized as rare were included in the list, and seven species were transferred from category 2 to category 3 due to improvements in the state of their natural populations. The fifth edition of the RDBUz (2019) contained information on 314 threatened species; 19 taxa were excluded following revisions of their taxonomic status and reassessment of population conditions. The substantial expansion and refinement of data in this edition became possible due to the publication of cadastral inventories of vascular plants for individual administrative regions of the country (Tojibaev et al., 2018a, 2018b). Of the 314 species listed in the fifth edition of the RDBUz, 35 are included in the IUCN Red List, 17 of these (seven species of the genus *Tulipa*, five species of the genus *Calligonum*, *Moluccella bucharica* (B.Fedtsch.) Ryding, *Zygophyllum bucharicum* B. Fedtsch., *Salvia korolkowii* Regel & Schmalh., *Ribes malvifolium* Pojark., and *Lonicera paradoxa* Pojark.) are classified as threatened (IUCN, 2026).

Nevertheless, all previous editions of the RDBUz were not based on targeted, comprehensive studies specifically designed to assess the current status of threatened species populations. The information provided therein on threats, distribution ranges, and population sizes was generally derived from individual floristic surveys, which often covered only a portion of the populations of the respective species. At the same time, it should be acknowledged that for a number of threatened plants, population status has been investigated in considerable detail within the framework of doctoral dissertations and applied research projects focused on assessing the condition of rare and endemic species (Tojibaev, 2010a, 2010b; Tojibaev et al., 2014, 2018a, 2018b; Shomurodov et al., 2015, 2018; Akhmedov, 2017; Khabibullaev, 2023; Khaitov, 2024). Moreover, unlike the previous editions, in the sixth edition of the RDBUz the population status of species was assessed according to the categories and criteria of the IUCN.

The aim of this study was to critically assess the conservation status of populations of both species previously included in the National Red Data Book of Uzbekistan an additional candidate species that have been recognized as rare and threatened by specialists in recent years. In addition, we aimed to align the Red Data Book of Uzbekistan with other regional Red Data Books by assessing the status of threatened species populations solely according to the categories and criteria of the IUCN.

2. Materials and methods

2.1. Study area

Uzbekistan, covering a total area of 448,924 km^2 (National Encyclopedia of Uzbekistan, 2006), is located in the middle of Central Asia between 37°11′–45°36′ N and 56°00′–73°10′ E (Fig. 1). The country borders Kyrgyzstan and Tajikistan to the east, Kazakhstan to the north, northeast, and northwest, Turkmenistan to the west and southwest, and Afghanistan to the south.

Geologically, Uzbekistan lies at the junction of the Western Tien Shan, Pamir-Alay, and the Turan Platform, reflecting a complex tectonic history from the Paleozoic to the Cenozoic (Zakirov et al., 2016). The resulting mountain–lowland contrast — Paleozoic-based ranges versus Mesozoic–Cenozoic platform sediments — has strongly shaped topography, soils, and hydrology, and consequently the distribution of flora (Sultanov, 2008).

The climate is sharply continental, characterized by pronounced seasonal temperature amplitudes and predominantly arid conditions. According to the Köppen–Geiger climate classification, lowland areas are mainly classified as BWk (cold desert) and BSk (cold semi-arid steppe), whereas foothill and mountainous regions correspond to more

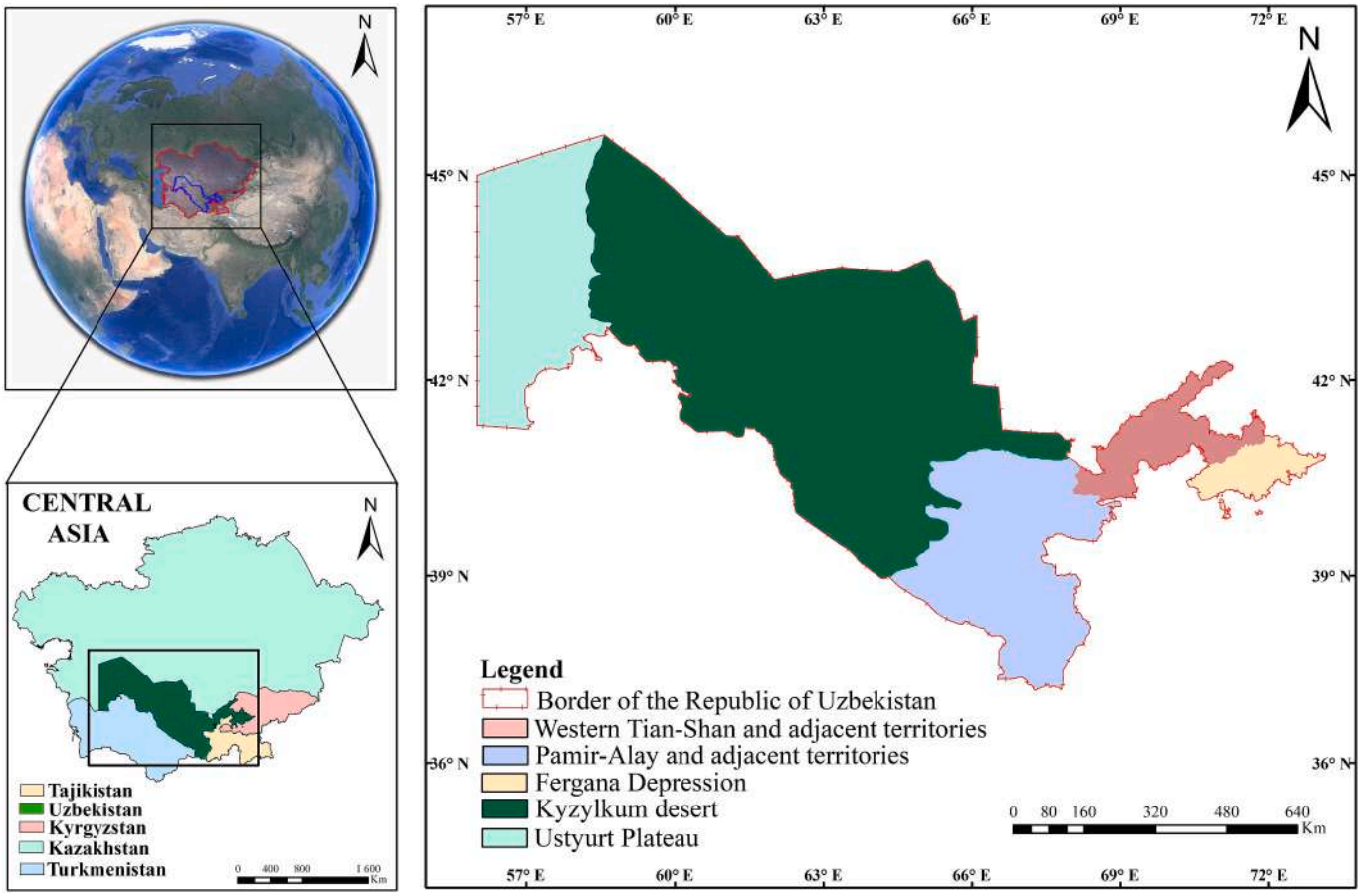

Fig. 1. Study area. Schematic division of the territory of Uzbekistan into the Western Tien Shan Mountain system and its adjacent areas, the Pamir-Alai Mountain system and its adjacent areas, the Fergana Depression (Central Fergana), the Kyzylkum Desert (including the dried bottom of the Aral Sea), and the Ustyurt Plateau.

humid temperate types (Csa, Dsa) (Beck et al., 2018). Mean January temperatures range from approximately +4 °C in the south to −10 °C in the north, while mean July temperatures vary from +27 °C in the north to +37 °C in the south. Mean annual precipitation averages 80–120 mm in desert regions and 400–800 mm in mountainous areas, with a pronounced spring maximum. Approximately 80% of the national territory is occupied by desert and semi-desert landscapes.

Biogeographically, the territory belongs to the Turanian Province of the Irano-Turanian floristic region, characterized by high level of plant endemism and the dominance of xerophytic vegetation. Representative desert ecosystems occur within the Kyzylkum Desert (including exposed Aral Seabed), Ustyurt Plateau and Fergana depression. Major mountain centers of plant diversity are associated with the Western Tien Shan and Pamir-Alai systems, which harbor a substantial proportion of rare and endemic plant species.

To analyze the threatened flora, it is possible to identify three major physiographic regions integrating both mountain and lowland landscape complexes: the Western Tien Shan and the Pamir-Alai – as well as in lowland areas, including the Kyzylkum Desert, the Ustyurt Plateau, and the Fergana intermontane depression (Fig. 1).

The Western Tien Shan in Uzbekistan includes the Ugam, Pskem, and Chatkal mountain ranges, occupying the eastern part of the country. According to Tojibaev (2010a, 2010b), the vascular flora of the Uzbek part of the Western Tien Shan comprises 2056 species, belonging to 647 genera and 104 families. This mountain region harbours 320 endemics, including 69 narrow endemics restricted to Uzbekistan (Tojibaev et al., 2020a, 2020b). The high level of endemism underscores the exceptional floristic value of the region and its importance for biodiversity conservation at both national and regional levels.

The system of protected areas in the Uzbek part of the Western Tien Shan includes the Ugam-Chatkal State Biosphere Reserve, the Ugam-Chatkal National Nature Park, and the Chatkal State Biosphere Reserve (Table 1). The total area of these protected territories amounts to approximately 574,539 ha (5745.39 km^2), which corresponds to about 5% of the country's total protected area (Fig. 2). At least 1800 species of vascular plants occur within these territories (Beshko et al., 2024), representing no less than 85% of the floristic diversity of the South-Western Tien Shan.

The Pamir-Alay in Uzbekistan includes the Turkestan, Zarafshan, Nuratau, Kugitang, Babatag and Gissar mountain ranges, occupying the southern part of the country. Despite more than a century of botanical exploration and a considerable body of empirical data, the floristic diversity of this mountain system remains insufficiently documented (Turginov, 2014; Azimova, 2017; Beshko, 2020; Po'latov, 2025).

The majority of the Uzbek part of the Pamir-Alay is located within two southern administrative regions of Kashkadarya and Surkhandarya, whose floristic composition has been published recently. These regions encompass the western part of the Gissar Range in Uzbekistan, one of the largest ranges in the Pamir-Alay system, as well as the adjacent territories. The flora of Kashkadarya region comprises 2022 taxa, of which 88 are included in the RDBUz (Tojibaev et al., 2018a). The flora of Surkhandarya region comprises 2191 taxa, of which 65 are strict national endemics and 126 are included in the RDBUz (Annual Report, 2024). Approximately 1450 vascular plants have been recorded in the Uzbek part of the Zeravshan Range (Kamelin, 1979), and about 1255 taxa in the Malguzar Range (part of the Turkestan Range) (Azimova, 2017). Both ranges are recognized as important centers of local endemism. The most complete data on flora and its threatened species are

Table 1
Area and Species Richness of Protected Areas in Uzbekistan.

Regions	Protected areas name	Area of protected territories, ha	Species richness of protected area
The Western Tien Shan	Ugam-Chatkal State Biosphere Reserve	42,892	1118
	Chatkal State Biosphere Reserve	24,706	774
	Ugam-Chatkal National Nature Park	506,941	1727
The Pamir-Alay	Gissar State Reserve	80,986	1216
	Surkhan State Reserve	23,802	747
	Nurata State Reserve	17,752	876
	Kitab National Nature Park	3938	798
	Zaamin National Nature Park	24,110	1216
	Aman-Kutan National Nature Park	1500	not documented
	Zarafshan National Nature Park	2426	416
	Upper Tupalang National Nature Park	27,851	not documented
	Babatag National Nature Park	12,064	867 (unpublished data)
	Durmen National Patk	32.4	not documented
	Kushrabad wildlife sanctuaries	16,500	not documented
	Nurabad wildlife sanctuaries	40,000	not documented
The Lowland regions	Lower Amudarya Biosphere Reserve	68,717	310
	Kyzylkum State Reserve	10,311	232
	Aktau-Tamdy State Reserve	40,000	not documented
	South Ustyurt National Nature Park	1,447,143	229 (unpublished data)
	Aralkum National Nature Park	1,000,000	197 (unpublished data)
	Khorezm National Nature Park	21,687	not documented
	Central Kyzylkum National Park	1,200,000	not documented
	Pap National Park	10,000	925 (unpublished data)
	Barsakelmes wildlife sanctuaries	280,000	not documented
	Arnasay wildlife sanctuaries	63,300	196 (unpublished data)
	Saigachiy wildlife sanctuaries	628,300	348 (unpublished data)
	Sudochye–Akpetki wildlife sanctuaries	280,507	not documented
	Dengizkul wildlife sanctuaries	50,000	not documented
	Karakyr wildlife sanctuaries	30,000	not documented
	Mubarek wildlife sanctuaries	264,469	not documented
	Karnabchul wildlife sanctuaries	25,000	not documented
	Kumsultan wildlife sanctuaries	4900	not documented
	Khadicha wildlife sanctuaries	11,300	not documented

Note: Natural monuments and botanical gardens are not included in the table.

available for the Nuratau Range, where 1283 taxa have been documented, including 32 strict national endemics and 46 species listed in the RDBUz (Beshko, 2020).

Overall, the plant diversity of the Uzbek part of the Pamir-Alay is largely encompassed by conservation measures (Fig. 2). A key role in the region's protected area system is played by the Gissar State Reserve — one of the largest in the mountainous regions of Uzbekistan, covering 80,986 ha. In addition, the Uzbek part of the Pamir-Alay includes two state reserves (Nuratau and Surkhan), seven national nature parks, and two wildlife sanctuaries (Table 1, Fig. 2). The floristic richness of the Gissar, Surkhan, and Nuratau reserves, as well as the Kitab, Zaamin, Zarafshan, and Babatag national nature parks, has been well studied (Karabalaeva, 2006; Ibragimov, 2009; Khassanov et al., 2013; Aromov and Omonov, 2023; Beshko et al., 2025a, 2025b; Kabulova et al., 2025). For the remaining protected areas of the Pamir-Alay, no floristic data is available.

The lowland regions are mainly represented by the Kyzylkum Desert, the Ustyurt Plateau, and partly by the Central Fergana. The vegetation of the lowland areas is characterized by relatively low floristic diversity compared to the mountainous regions. The flora of the Kyzylkum Desert comprises approximately 1050 vascular plants, of which 41 are endemics of the Kyzylkum, including 13 strict endemics to Uzbekistan (Khassanov et al., 2011; Shomurodov and Khassanov, 2014). The floristic richness of the Uzbek part of the Ustyurt Plateau amounts to 625 species (Tajetdinova, 2018), with a single narrowly distributed strict endemic (*Allium ravenii* F.O.Khass., Shomur. & Kadyrov). According to unpublished data, the vascular flora of Central Fergana comprises approximately 786 taxa (K. Sh. Tojibaev, personal communication). A comprehensive grid-based inventory of plant diversity in this region is currently underway.

Over the past ten years, the area of protected natural territories (PNTs) in the lowland zone of Uzbekistan has nearly tripled due to the expansion of the Lower Amudarya Biosphere Reserve, the establishment of new national nature parks (South Ustyurt, Barsakelmes, Aralkum, Chust-Pap), the Aktag–Tamdy State Reserve, as well as several wildlife sanctuaries (Saigachiy, Sudochye–Akpetki) (Fig. 2). Despite this quantitative growth in PNTs, the coverage of threatened plant species recommended for inclusion in the latest edition of the RDBUz remains insufficient.

2.2. Flora checklist and conservation status assessment protocol

In the latest edition of the RDBUz, the assessment of species' population status was carried out within the framework of a targeted project funded by the National Committee for Ecology and Climate Change of the Republic of Uzbekistan during 2023–2025.

The list of threatened species was compiled based on previous editions of the RDBUz and relevant literature reporting the status of populations of rare and endangered plant species in Uzbekistan (Tojibaev et al., 2020a, 2020b, 2022; Shomurodov and Khabibullaev, 2022, Shomurodov et al., 2024; Akhmedov, 2017; Saribaeva et al., 2022; Orsenigo et al., 2022, 2025, 2026; Fenu et al., 2022, 2023, 2024, 2025; Turginov, 2025; Beshko et al., 2025a, 2025b; Khabibullaev et al., 2026).

The taxonomic treatment of plant species were standardized according to the Plants of the World Online database (POWO, 2026).

To plan field expeditions for each target plants, we used geographic records provided in previous Red Data Books (Khassanov, 2019), the recent volumes of the Flora of Uzbekistan (Sennikov et al., 2016, Sennikov, 2017, 2019, 2022a, 2022b, 2023), regional floristic cadastres (Tojibaev et al., 2018a, 2018b, 2019a, 2019b, 2020a, 2020b, 2021; Beshko et al., 2024), and the electronic database of the National Herbarium TASH at the Institute of Botany, Academy of Sciences of the Republic of Uzbekistan.

Field activities were planned based on critically revised distributional data, including literature records, herbarium specimens, and occurrence data from online platforms such as GBIF, Plantarium, and iNaturalist (GBIF, 2026; Plantarium, 2026; iNaturalist, 2026). GBIF and iNaturalist data were filtered using research-grade records only, with removal of duplicates, exclusion of cultivated and georeferencing outliers, and manual verification of questionable records. The ecology and biology of the studied species were considered, including their altitudinal preferences, specific habitats, associated plant communities, substrate types, life forms, and phenology. This integrative approach ensured targeted and efficient field surveys, maximizing the likelihood

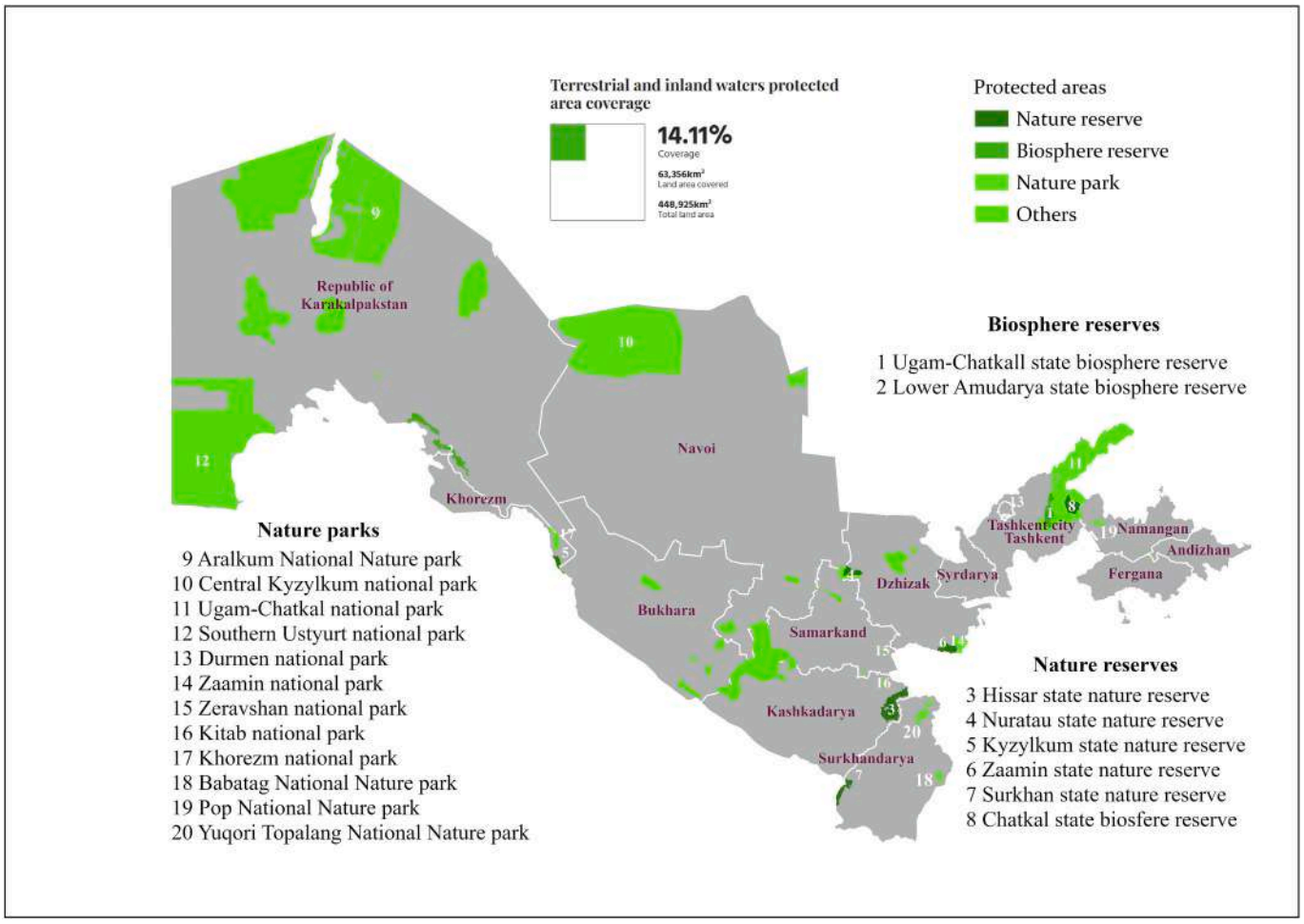

Fig. 2. Protected natural areas of Uzbekistan.

of locating populations of the target species.

The populations of the almost all species were assessed over the past three years (2023–2025). The population size and age structure were assessed by establishing 10 m^2 transects subdivided into ten 1 m^2 sampling plots; between 3 and 10 replicates were laid out depending on the size of the local population. At each study site, existing threats were thoroughly documented.

The conservation status of the vascular plants was assessed according to the IUCN categories and criteria (version 3.1; IUCN, 2012). The assessment was based on IUCN Criteria A–E, which consider (A) population reduction, (B) geographic range size including EOO and AOO together with fragmentation, decline or fluctuation, (C) small population size and decline, (D) very small or restricted population, and (E) quantitative analysis of extinction risk. These criteria have been applied following the most up-to-date guidelines at regional level (IUCN, 2024). These criteria provide a globally recognized quantitative framework for evaluating extinction risk based on species distribution, population parameters, and observed or inferred trends (IUCN, 2026).

Extent of occurrence (EOO) and area of occupancy (AOO) were calculated using GeoCAT (Bachman et al., 2011) by entering all known occurrence records of each species within Uzbekistan into the program. To systematically identify and classify the direct threat factors impacting the studied species, the IUCN Threats Classification Scheme (Version 3.3; IUCN, 2023) was applied, which provides a standardized hierarchical framework for categorizing anthropogenic and natural threats to biodiversity at the species and ecosystem levels. Based on the main threat, the number of locations were counted for each plant. Population data and demographic trends directly collected in the field were used to apply criteria A, C, D and E. The EX assessment was based on the absence of records during long-term targeted field surveys, the resurvey of historical localities, and a comprehensive analysis of available herbarium and literature data. In addition to species previously included in the national Red Data Book, newly evaluated taxa were selected based on recent field surveys, herbarium revisions, taxonomic updates, and newly available distributional and population data. Species were considered for assessment when the accumulated evidence indicated that they potentially met one or more of the IUCN Red List Categories and Criteria at the national level or when newly available information warranted a reassessment of their conservation status.

All statistical analyses were conducted using R and Origin software (R Core Team, 2021), and spatial maps were generated using QGIS software (QGIS Development Team, 2009).

3. Results

A large-scale inventory and evaluation of the current status of populations of 367 vascular taxa were conducted. Of these, 314 species had been previously included in the fifth edition of the RDBUz, while 53 species were considered as candidates for inclusion in the new edition. Following a critical analysis, 23 of these species and one subspecies were identified as threatened with extinction and were recommended for inclusion, for the first time, in the latest (sixth) edition of the RDBUz (Fig. 3, Supplementary Table S1).

In addition, due to taxonomic revisions, refinements in geographic distribution, and the recovery of natural populations, 21 species previously included in the RDBUz were recommended for removal from the

Fig. 3. Some species newly proposed for the Red Data Book of Uzbekistan: a) *Parrya tojibaevii* D.A.German & Madaminov b) *Rhamnus erythroxyloides* subsp. *sintenisii* (Rech.f.) Mabb., c) *Astragalus kuldzhuktauense* F.O. Khass., Shamur. & Esankulov d) *Dracocephalum adylovii* I.I. Malzev, e) *Phlomoides kirghisorum* Adylov, Kamelin & Makhm., f) *Acantholimon zakirovii* Beshko, g) *Oxytropis kamelinii* Vassilcz., h) *Phlomoides michaelis* Adylov, Kamelin & Makhm., i) *Iris austrotschatkalica* Tojibaev, F. Karimov & Turgunov, j) *Allium haneltii* F. O. Khass. & R. M. Fritsch, k) *Tulipa borszczowii* Regel, l) *Acanthophyllum krascheninnikovii* Schischk. m) *Moluccella fedtschenkoana* (Kudr.) Ryding n) *Allium arkitense* R.M.Fritsch, o) *Tulipa butkovii* Botschantz., p) *Allium svetlanae* Vved.. (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

new edition (Supplementary Table S2). Field data demonstrated that both the overall distribution range and the area occupied by populations of these species are substantially larger than previously assumed. In addition, no significant threats to this populations have been identified. An exception is represented by *Tulipa intermedia* Tojibaev & J. de Groot, originally described from the Fergana Valley (Uzbekistan) and currently treated as a synonym of *Tulipa korolkowii* Regel, which also occurs in the neighboring countries (Kazakhstan, Kyrgyzstan, and Tajikistan). Despite its wider distribution, the Uzbek populations of this species continue to face anthropogenic pressure mainly related to overgrazing, land conversion for agricultural use, and increasing recreational activities. Accordingly, the status of this species at regional level (Uzbekistan) has been assessed as Vulnerable (VU) based on the formula B1ab(ii,iii,iv).

No significant threats have been identified for six taxa, due to either their wide distribution outside the territory of Uzbekistan or their occurrence within the boundaries of protected areas (*Erigeron trimorphopsis* Botsch., *Olgaea pectinata* Iljin, *Elwendia vaginata* (Korovin) Pimenov & Kljuykov, *Lomatocarpa alata* (Korovin) Pimenov & Sennikov, *Dimorphosciadium gayoides* (Regel & Schmalh.) Pimenov, *Euphorbia sclerocyathium* Korovin & Popov). Several other species previously considered Vulnerable show signs of recovery in their natural populations, in particular *Tulipa dasystemon* (Regel) Regel (a Central Asian endemic) and *Climacoptera amblyostegia* (Botsch.) Botsch. (a narrowly distributed endemic of Uzbekistan).

Special attention should be given to *Sternbergia lutea* (L.) Spreng., which was listed in previous editions of the RDBUz with Status 3 (species with declining populations). However, this taxon represents an introduced ornamental species that has locally naturalized in Uzbekistan. Data from international floristic databases and major regional floras (POWO, 2024; Davis, 1984; Speta, 1987.) demonstrate that *S. lutea* has a broad native distribution across the Mediterranean region, Anatolia, and Iran. Given its non-native origin in Uzbekistan and the absence of evidence for naturally occurring populations within the country, the inclusion of this species in the Red Data Book is not justified. Accordingly, but for which its removal from the forthcoming edition of the Red Data Book of Uzbekistan has been recommended (Supplementary Table S2).

Overall, the most recent edition of the RDBUz includes 317 taxa of vascular plants. The majority of these taxa are narrowly distributed: 207 are endemic to Uzbekistan and 92 are confined to Central Asia (Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan, and Uzbekistan), whereas only 18 taxa have broader distributions.

A taxonomic analysis indicates that these taxa are predominantly confined to five families, notably Fabaceae (58 taxa), Asteraceae (40 taxa), Lamiaceae (35 taxa), Apiaceae (25 taxa), and Liliaceae (21 taxa),

each represented by more than 20 taxa recommended for inclusion in the RDBUz (Fig. 4). Within the family Fabaceae, the highest concentration of threatened species is found in *Astragalus* whit 37 species of this genus recommended for inclusion in the RDBUz, 27 of them strict national endemics. The genera *Oxytropis* and *Hedysarum* follow in terms of the number of vulnerable species, represented by seven and five endemic species, respectively. The remaining genera (eight in total) are characterized by one or two threatened species each (Table 2).

Within the families Asteraceae and Lamiaceae, the greatest numbers of threatened species occur in the genera *Cousinia* (20 species), *Jurinea* (6 species), *Phlomoides* (10 species), *Salvia* (6 species), and *Scutellaria* (5 species). In the family *Apiaceae*, the largest number of threatened species belongs to the genus *Ferula*, which is characterized by a high level of Central Asian endemism. Of the 29 species of this genus recorded in Uzbekistan, three strict national endemics (*F. kyzylkumica*, *F. helenae*, *F. pratovii*) and six subendemics with a Central Asian distribution (*F. fedtschenkoana*, *F. korshinskyi*, *F. sumbul*, *F. tadshikorum*, *F. tuberifera*) have been assessed as threatened.

Among the 22 threatened species of the family Liliaceae included in the RDBUz, 20 belong to the genus *Tulipa* As early as the first edition of the RDBUz (1984), 23 species of *Tulipa* were included, reflecting the high vulnerability of this genus under regional conditions.

Among all taxa considered (317; Fig. 5), only one is classified as Extinct (EX; Dipcadi turkestanicum), while the majority of species falls into the categories Endangered (EN; 168 taxa) and Vulnerable (VU; 56 taxa), followed by Critically Endangered (CR; 41 taxa, 26 of them endemics of Uzbekistan), indicating an extremely high risk of extinction. Finally, 7 taxa are classified as Near Threatened (NT), 44 taxa as Data Deficient (DD) and, among them three species (*Oenanthe fedtschenkoana* Koso-Pol., *Euphorbia kudrjaschevii* (Pazij) Prokh., and *Astragalus alexeji* Gontsch.) are also considered potentially extinct since there are no recent reports.

An analysis of population declines and the degree of habitat fragmentation identified eight categories of main threats according to the IUCN classification: (a) Residential & commercial development, (b) Agriculture & aquaculture, (c) Energy production & mining, (d) Biological resource use, (e) Human intrusions & disturbance, (f) Natural system modifications, (g) Geological events, and (h) Other factors, including climate variability, extreme weather events, and localized anthropogenic pressures not covered by the above categories. The most wide spread threat is represented by theunregulated livestock grazing: 75.7% of the plant species recommended for inclusion in the new edition of the RDBUz are affected by it (Fig. 6).

Populations of 98 species (30.9%) are declining due to land conversion for agriculture. This type of threat is particularly acute in the lowland areas of the Fergana Valley, which are characterized by high

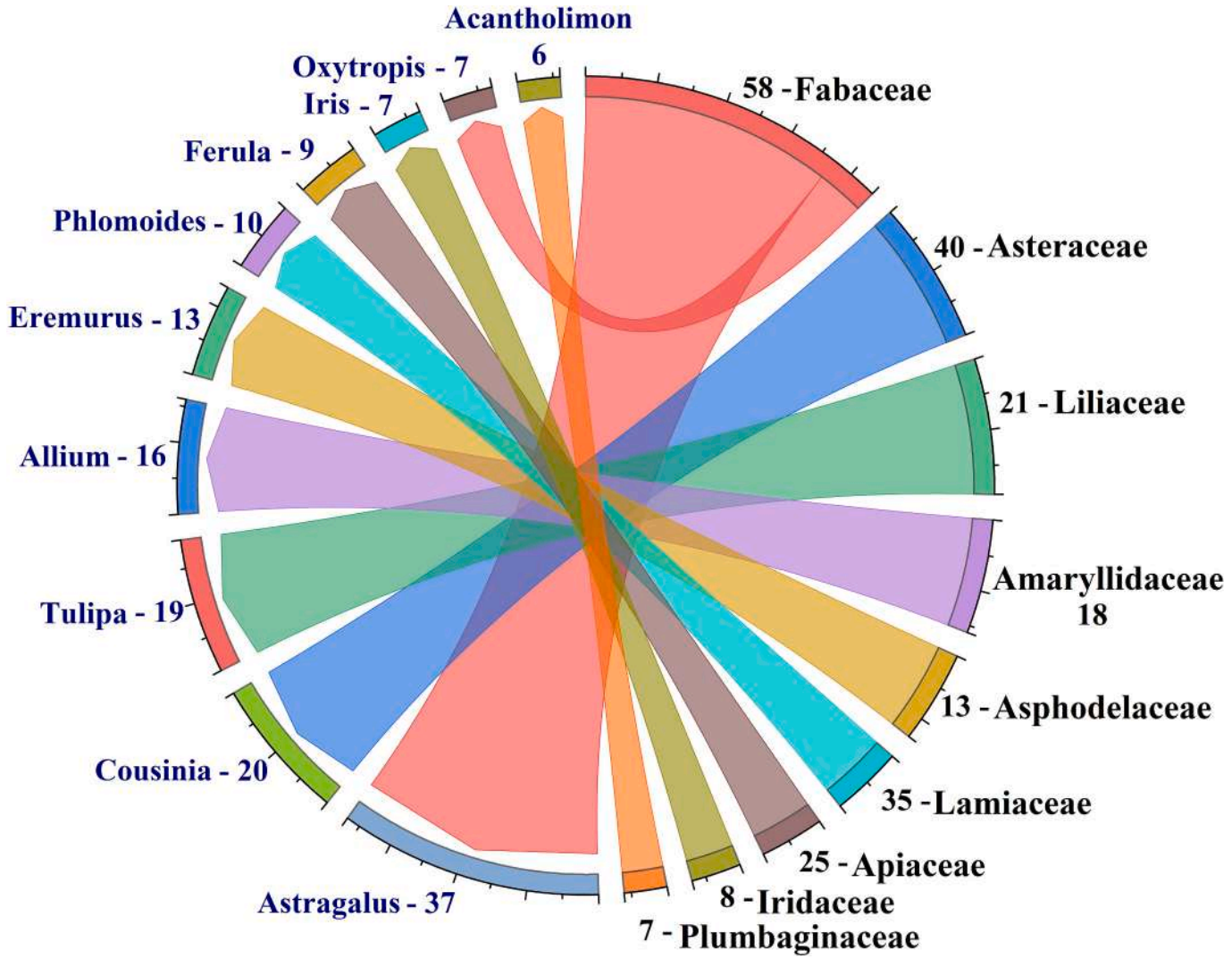

Fig. 4. Taxonomic structure of threatened species, highlighting the families and genera with the highest number of Red List species. (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

Table 2
Species proposed for inclusion in the National Red List of Uzbekistan.

N⁰	Taxon	IUCN Red List category	IUCN Red List Criteria	IUCN Threats ID
Amaryllidaceae J.St.-Hil.				
1	*Allium aflatunense* B. Fedtsch.	VU	B1ab(iii) + B2ab(iii).	5.2
2	*Allium alaicum* Vved.	CR	B1ab(iii); C2a(i).	2.3
3	*Allium arkitense* R.M. Fritsch	EN	B1ab(i,iii,iv, v) + B2ab(ii, iv) C2a(i).	2.3, 2.1
4	*Allium backhousianum* Regel	CR	B1ab(i,ii,iii, iv,v) + 2ab(i, ii,iii,iv,v); C2a(i).	2.3
5	*Allium botschantzevii* Kamelin	CR	B1a,b(ii,iii, v) + 2a,b(ii, iii,v); D.	2.3
6	*Allium decoratum* Turginov & Tojibaev	EN	B1,b(ii) + B2,b(iii, iv).	2.3
7	*Allium eremoprasum* Vved.	EN	B1ab(ii,iii, iv) + B2ab(ii, iii,iv) + C2a (i).	2.3,3.2
8	*Allium giganteum* Regel	VU	B1a,b(iii, iv) + B2a,b(ii, iii).	2.3
9	*Allium haneltii* F.O.Khass. & R.M.Fritsch	EN	B1ab(i) + 2ab(ii,iii,iv); C2a(i).	2.3,2.1
10	*Allium isakulii* R.M.Fritsch & F.O.Khass.	VU	B2ab(ii,iii); C2a(i).	2.3,3.2
11	*Allium majus* Vved.	EN	B1b(iii) + B2b, (i).	2.3,5.2
12	*Allium praemixtum* Vved.	VU	B1ab(ii,iii,v) + B2ab(ii,iii, v) + C2a(i).	2.3,3.2
13	*Allium pskemense* B. Fedtsch.	VU	B1b(iv,v) + 2b(iii,iv,v).	5.2
14	*Allium ravenii* F.O.Khass., Shomur. & Kadyrov	CR	B1ab (i, ii, iii, v) c (iv) + 2ab (i, ii, iii, v) c (iv) + C1 + C2a (i, ii) + D.	10.3
15	*Allium svetlanae* Vved.	EN	B1ab(iii,v) + 2ab(iii,v).	2.3,3.2,10.3
16	*Allium viridiflorum* Pobed.	CR	B1ab(i,ii,iii, iv,v) + 2ab(i, ii,iii,iv,v); C2a(i).	2.3
17	*Sternbergia fischeriana* (Herb.) M.Roem.	EN	B1ab(iii,v) +2ab(iii,v).	2.3,5.2
18	*Ungernia victoris* Vved. ex Artjuschenko	VU	B1b(ii,iii,iv) + 2b(iii).	2.3,5.2
Amaranthaceae Juss.				
19	*Anthochlamys tjanschanica* Iljin ex Aellen.	EN	B2ab(i,iii).	2.3,2.1
20	*Climacoptera malyginii* (Korovin ex Botsch.) Botsch.	DD		2.3,2.1
21	*Climacoptera merculowitschiii* (Zakirov) Botsch.	EN	B1b,c (ii,iii, iv).	2.3,2.1
22	Climacoptera oxyphylla U. P.Pratov	DD		2.3,2.1
23	Climacoptera pjataevae U. P.Pratov	DD		2.3
24	*Climacoptera ptiloptera* U. P.Pratov	DD		2.3,2.1
25	*Halimocnemis ferganica* (Iljin) Akhani ex Sennikov	VU	B1ab(i,iii) + 2ab(ii,iv).	2.3,10.3,7.3
26	*Halimocnemis lasiantha* Iljin	VU	B1ab(I,iii) + 2ab(ii,iv).	2.3,2.1
27	*Nanophyton botschantzevii* U.P.Pratov	EN	B1a,b(ii,iii, iv) + 2a,b(ii, iii,iv).	2.3, 1.3, 6.1
28	*Oreosalsola drobovii* (Botsch.) Akhani	VU	B1b(i,ii,iii,iv, v) + 2ab(iii).	2.3,2.1
29	*Xylosalsola chiwensis* (Popov) Akhani & Roalson	NT		12.1
Anacardiaceae R.Br.				
30	*Rhus coriaria* L.	EN	B2b(i,ii,iii,iv, v).	2.3,5.3
31	*Astomatopsis galiocarpa* Korovin	EN	B1b(i,ii,iii,v) + 2b(iii).	2.3,2.1
32	*Aulacospermum popovii* (Korovin) Kljyukov, Pimenov & V.N.Tikhom.	EN	B1a,b(ii,iii, iv) + 2a,b(ii, iii,iv); C2a(i).	2.3,1.2
33	*Autumnalia inopinata* Pimenov	EN	B1ab(*iii*)c (iv) + 2ab(*iii*) c(iv);C2a(*i*)b.	2.3,3.2, 1.3, 6.1
34	*Cephalopodum hissaricum* Pimenov	DD		12.1
35	*Dorema microcarpum* Korovin	VU	B1ab(i,iii) + 2abc(ii,iv).	2.3,2.1
36	*Elwendia angreni* (Korovin) Pimenov & Kljuykov	EN	B1ab(*iii*)c (iv) + 2ab(*iii*) c(iv).	2.3,10.3
37	*Fergania polyantha* (Korovin) Pimenov	EN	B2abc(ii,iv).	2.3,2.1
38	*Ferula fedtschenkoana* Koso-Pol.	EN	B1a,b(i,iii) + 2b(ii,iii,iv).	2.3,2.1,10.3
39	*Ferula helenae* Rakhm. & Melibaev	EN	B1a,b (i,iii,iv, v) + 2a,b(ii, iii,iv,v); C2a (*i*)b.	2.3,3.2
40	*Ferula korshinskyi* Korovin	DD		2.3, 1.3, 6.1
41	*Ferula kyzylkumica* Korovin	VU	B2b(i,ii,iii,iv, v).	2.3,3.3
42	*Ferula pratovii* F.O.Khass. & I.I.Malzev	CR	B1ab(i,iii,iv) + 2ab(ii,iii, iv).	2.3,10.3
43	*Ferula sumbul* (Kauffm.) Hook. f.	VU	B2ab(iii,iv); C2a(i).	2.3
44	*Ferula tadshikorum* Pimenov	NT		5.2
45	*Ferula tuberifera* Korovin	EN	B1ab(i,iii,v) +2ab(ii,iii, v).	2.3,2.1
46	*Ferula vicaria* Korovin	DD		2.3,2.1
47	*Kamelinia tianschanica* F. O.Khass. & I.I.Malzev	EN	B1ac(iii) + 2ac(iii);C2b.	2.3
48	*Komarovia anisosperma* Korovin	EN	B1a,b(ii,iii, v) + 2a,b(ii, iii,v).	2.3
49	*Kuramosciadium corydalifolium* Pimenov, Kljuykov & Tojibaev	EN	B1a,b(iii) + 2a,b(iii);C2a (i).	2.3,10.3
50	*Oenanthe fedtschenkoana* Koso-Pol.	DD		2.3,2.1
51	*Paulita ovczinnikovii* (Korovin) Sojak	VU	B1ab(i,ii,iii, iv,v);C1.	2.3,5.2
52	*Seseli turbinatum* Korovin	VU	A4ac.	2.3
53	*Sphaenolobium tenuisectum* (Korovin) Pimenov	EN	B1a,b(iii) + 2a,b(iii);C2a (i).	2.3,2.1,1.2
54	*Sphaerosciadium denaense* (Schischk.) Pimenov & Kljuykov	EN	B2ab(iii,iv, v).	2.3,10.3
55	*Zeravschania regeliana* Korovin	EN	B1ab(iii,v) + 2ab(iii,v).	2.3,2.1,5.2
Asphodelaceae Juss.				

(*continued on next page*)

Table 2 (*continued*)

N°	Taxon	IUCN Red List category	IUCN Red List Criteria	IUCN Threats ID
56	*Eremurus aitchisonii* Baker	VU	B1a,b(i,iii) + 2a,b(ii,iii).	5.2
57	*Eremurus alberti* Regel	EN	B2a, b(ii, iii).	5.2
58	*Eremurus baissunensis* O. Fedtsch.	EN	B1a,b(ii,iii) + 2a,b(ii,iii).	2.3,12.1
59	*Eremurus chloranthus* Popov	DD		2.3
60	*Eremurus iae* Vved.	EN	B2a,b(ii,iii).	2.3
61	*Eremurus korovinii* B. Fedtsch.	DD		2.3
62	*Eremurus lachnostegius* Vved.	EN	B1a,b(ii,iii) + 2a,b(ii,iii).	5.2,12.1
63	*Eremurus lactiflorus* O. Fedtsch.	NT		2.3,5.2
64	*Eremurus luteus* Baker	EN	B1a,b(ii,iii) + 2a,b(ii,iii).	5.2,12.1
65	*Eremurus nuratavicus* A.P. Khokhr.	EN	B1a, b(ii, iii) + B2a, b(ii, iii).	2.3,3.2
66	*Eremurus pubescens* Vved.	EN	B1a,b(i,iii) + B2a,b(i,iii).	2.3,5.2
67	*Eremurus robustus* Regel	VU		2.3,2.1,5.2
68	*Eremurus suworowii* Regel	EN	B2a,b(ii,iii, iv,v).	2.3,2.1
Asteraceae Bercht. & J.Presl				
69	*Arctium dolichophyllum* (Kult.) S.López, Romasch., Susanna & N.Garcia (*Cousinia dolichophylla* Kult.)	VU	B1b (i, iii, iv); D2.	2.3,3.2
70	*Arctium haesitabundum* (Juz.) S.López, Romasch., Susanna & N.Garcia (*Cousinia haesitabunda* Juz.)	CR	B1ab(ii,iii, iv) + 2ab(ii, iii,iv).	2.3
71	*Arctium pallidivirens* (Kult.) S.López, Romasch., Susanna & N.Garcia	VU	B2ab(ii,iii,iv, v); C2a(i).	2.3,2.1,1.2
72	*Arctium pterolepidum* (Kult.) S.López, Romasch., Susanna & N.Garcia (*Cousinia pterolepida* Kult.)	EN	B1ab(ii,iii, iv) + 2ab(ii, iii,iv).	2.3
73	*Cousinia adenophora* Juz.	EN	B1a,b(i,ii,iii) + 2a,b(ii,iii) + C2a(i).	2.3
74	*Cousinia allolepis* Tscherneva & Vved.	EN	B1a,b(i,iii, iv) + 2a,b(ii, iii,iv).	2.3
75	*Cousinia butkovii* Tscherneva & Vved.	VU	B1a,b(ii,iii) + 2a,b(ii,iii).	12.1
76	*Cousinia campyloraphis* Tscherneva	EN	B1a,b(i,iii) + 2a,b(ii,iii) + C2a(i).	2.3
77	*Cousinia candicans* Juz.	EN	B1b(i,ii,iii) + 2b(ii,iii,v).	12.1
78	*Cousinia dshisakensis* Kult.	EN	B2a,b(ii,iii, iv,v).	12.1
79	*Cousinia glabriseta* Kult.	EN	B1ab(i,ii,iii, v) + 2ab(ii, iii,v).	2.3,2.1
80	*Cousinia glaphyrocephala* Juz. ex Tscherneva	DD		2.3
81	*Cousinia hoplophylla* Tscherneva	**CR**	B1ab(i,ii,iii, iv,v); C2a(i).	2.3
82	*Cousinia platystegia* Tscherneva	DD		12.1
83	*Cousinia praestans* Tscherneva & Vved.	**CR**	B1ab(i,iii) + 2ab(ii,iii) + C2a(i).	2.3,2.1
84	*Cousinia pseudolanata* Popov ex Tscherneva	CR	B1ab(i,iii) + 2a(ii,iii,iv,v).	12.1
85	*Cousinia rhodantha* Kult.	EN	B1a,b(i,iii,v) + 2a,b(i,ii,iii, iv,v).	2.3,2.1,3.1
86	*Cousinia spryginii* Kult.	VU	B1ab(ii,iii) + B2a,b(ii,iii) + C2a(i).	2.3,3.1
87	*Cousinia stricta* Tscherneva	EN	B1a,b(i,ii,iii, iv,v) + 2b(ii, iii,v) + C2a (i).	12.1
88	*Cousinia umbilicata* Juz.	EN	B1ab(i,ii,iii) + 2ab(i,ii,iii) + D.	2.3,3.2
89	*Cousinia vvedenskyi* Tscherneva	EN	B1a,b(ii,iii) + 2a,b(i,iii).	2.3
90	*Echinops babatagensis* Tscherneva	EN	B1ab(i,ii,iii, iv,v) + 2ab(i, ii,iii,iv,v).	2.1
91	*Echinops brevipenicillatus* Tscherneva	EN	B1a,b (i,ii,iii, iv) + 2a,b (ii, iii,iv).	2.3
92	*Helichrysum nuratavicum* Krasch.	VU	B1b(ii,iii,iv, v) + 2b(ii,iii, iv,v);C2a(i).	3.2
93	*Jurinea asperifolia* Iljin	DD		2.3
94	*Jurinea gracilis* Iljin	EN	B1b(i,ii,iii,iv, v) + 2b(i,ii, iii,iv,v).	12.1
95	*Jurinea mariae* Pavlov	EN	B1b(ii,iii,iv) + 2b(ii,iii, iv).	12.1
96	*Jurinea psammophila* Iljin	EN	B1b(i,ii,iii,iv, v) + 2ab(ii, iii,iv).	2.3,3.2
97	*Jurinea sangardensis* Iljin	EN	B1b(i,ii,iv,v) + 2b(i,ii,iv, v).	2.3,2.1
98	*Jurinea zakirovii* Iljin	EN	B2ab(ii,iii,iv, v); C2a(i).	2.3,3.2
99	*Lamyropappus schacaptaricus* (B.Fedtsch.) Knorring	CR	B1b(i,iii,iv) + 2ab(ii,iii, v).	2.3
100	*Lepidolopha fedtschenkoana* Knorring	EN	B1ab(i,iii,v) + 2b(ii,iii,iv, v).	2.3,2.1
101	*Lepidolopha nuratavica* Krasch.	VU	B1ab(ii,iii) + 2ab(ii,iii); C2a(i).	2.3,3.2
102	*Scorzonera bungei* Krasch. & Lipsch.	EN	B2b (ii, iii, iv, v); C2b.	2.3,2.1
103	*Serratula lancifolia* Zakirov	DD		12.1
104	*Tanacetopsis botschantzevii* (Kovalevsk.) Kovalevsk.	EN	B1ab(i,ii,iii, v) + 2a,b(ii, iii,iv).	10.3,12.1
105	*Trichanthemis butkovii* Kovalevsk.	DD		10.3,1.3, 6.1
106	*Ugamia angrenica* (Krasch.) Tzvelev	VU	B1a,b(iii,v) + 2a,b(iii,v); C2a(i).	1.3, 6.1
107	*Vicoa krasheninnikovii* Kamelin	CR	B1ab(ii,iii, iv) + 2ab(i, ii);C2a(i);D.	2.3
108	*Xylanthemum rupestre* (Popov ex Nevski) Tzvelev	EN	B1a,b (i,iii, iv) + 2a,b (ii, iii,iv).	2.3
Bignoniaceae Juss.				
109	*Incarvillea olgae* Regel	DD		2.3
Boraginaceae Juss.				

(*continued on next page*)

Table 2 (*continued*)

N°	Taxon	IUCN Red List category	IUCN Red List Criteria	IUCN Threats ID
110	*Heliotropium bucharicum* B. Fedtsch.	EN	B1ab(i,iii,iv, v) + 2ab(ii, iii).	2.3,3.1
111	*Lappula aktaviensis* Popov & Zakirov	DD		2.3,3.2
112	*Lappula nuratavica* Nabiev & Zakirov	EN	B1b(i,iii,iv, v) + 2b(ii,iii, iv,v).	2.3,3.2
113	*Lappula parvula* Nabiev & Zakirov	CR	A2abc; B1bv (i,iii,iv); C2 (b).	2.3,1.2
114	*Nonea calceolaris* Nikif. & Pazij	CR	B1c (i,ii).	2.3,2.1
115	*Onosma macrorhiza* Popov	EN	B1ab(i,ii,iii, iv,v) + 2ab(i, ii,iii,iv,v).	2.3,3.1
116	*Rindera fornicata* Pazij	EN	B1ab(i,ii,iii, iv,v) + 2ab(i, ii,iii,iv,v).	12.1
Brassicaceae Burnett				
117	*Crambe edentula* Fisch. & C.A.Mey. ex Korsh.	EN	B1b(I,ii,iii,iv, v) +2ab(I,ii, iii,iv,v).	10.3
118	*Crambe gordjaginii* Sprygin & Popov	EN	B1a (ii,v) + 2ab(iii).	2.3,2.1
119	*Iskandera hissarica* N. Busch.	EN	B1a,b(I,ii,iii) + 2b(ii,iii,iv, v).	2.3,10.3
120	*Lepidium olgae* (R.M. Vinogr.) Al-Shehbaz & Mumm.	EN	B1ab(ii,iii,iv, v) + 2ab(ii, iii,iv,v); C2a (i).	2.3,3.2
121	*Lepidium subcordatum* Botsch. & Vved.	VU	A2abc; C1.	2.3,3.2,3.3
122	*Parrya kuramensis* Botsch.	DD		2.3
123	*Parrya sarawschanica* (Regel & Schmalh.) D.A. German & Al-Shehbaz	EN	B1bc(ii,iii,iv, v); C2a(ii).	2.3,2.1
124	*Parrya saxifraga* Botsch. & Vved.	EN	B1ab(ii,iii, iv) + B2ab(ii, iii,iv) + C2a (i).	3.2, 1.3, 6.1
125	*Parrya tojibaevii* D.A. German & Madaminov	CR	B1bc(ii,iii,iv, v) + C2a(ii).	2.3,2.1
126	*Parrya tschimganica* (Popov ex Botsch. & Vved.) D.A.German & Al-Shehbaz	EN	B1b(I,iii,iv) + 2bc(ii,iii, iv).	2.3,2.1
127	*Spryginia winkleri* (Regel) Popov	EN	B1a,b(I,iii) + 2a,b(ii,iii).	2.3,2.1
Campanulaceae Juss.				
128	*Ostrowskia magnifica* Regel	EN	B1b(i,ii,iii, iv) + 2b(i,ii, iii,iv).	3.2
Capparaceae Juss.				
129	*Capparis rosanowiana* B. Fedtsch.	CR	B1a (i,iii,v) + 2a (ii,iii,iv, v); C1.	3.2
130	*Cleome gordjaginii* Popov	VU	B1b(i,iii,iv) + 2b(ii,iii, iv);C.	2.3,2.1
Caprifoliaceae Juss.				
131	*Lonicera paradoxa* Pojark.	EN	B1ab(ii,iii, iv) + 2ab(ii, iii,iv); D.	2.3,2.1
Caryophyllaceae Juss.				
132	*Acanthophyllum albidum* Schischk.	EN	B2ab(ii,iii).	2.3,2.1
133	*Acanthophyllum cyrtostegium* Vved.	EN	B1ab(i,ii,iii, iv,v) + 2ab(i, ii,iii,iv,v);E.	2.3,3.2,3.3
134	*Acanthophyllum krascheninnikovii* Schischk.	VU	B1a(i,ii,iii) + 2ab(i,ii, iii); C2a(i).	2.3,3.2,3.3
135	*Dianthus uzbekistanicus* Lincz.	VU	B1b(i,iii,iv, v) + 2b(ii,iii, iv,v).	2.3,2.1,5.2
136	*Silene michelsonii* Preobr.	EN	B1a,b(i,iii).	12.1
137	*Silene nataliae* F.O.Khass. & I.I.Malzev	DD		12.1
138	*Silene oreina* Schischk.	EN	B1,a,b(i,iii) + 2b(ii,iii); C2a(i).	1.3, 6.1
139	*Silene paranadena* Bondarenko & Vved.	EN	B1b(ii,iii,iv, v) + 2b(ii,iii, iv,v);C2a(i).	2.3
140	*Silene popovii* Schischk.	EN	B1b (i,ii,iii, iv,v) + 2a,b (iii);C2a(i).	2.3
141	*Silene tomentella* Schischk.	EN	**B1b(i,ii,iii, iv,v) + 2ab (i,ii,iii,iv,v).**	2.3,3.2,3.3
Caryophyllaceae Juss.				
142	*Colchicum kesselringii* Regel	VU	B2b(ii,iii,iv, v);C1.	2.3,5.2
Crassulaceae J.St.-Hil.				
143	*Pseudosedum campanuliflorum* Boriss.	EN	A3c; B2ab(i, ii,iii,v); C1.	12.1
Cucurbitaceae Juss.				
144	*Bryonia melanocarpa* Nabiev	**EN**	B1a,b(i,iii) + 2a,b(ii,iii).	2.3
Cynomoriaceae Endl. ex Lindl.				
145	*Cynomorium coccineum* subsp. *songaricum* (Rupr.) J.Léonard	VU	B1b (I,iii,iv); D2.	2.3,2.1,5.3
Ebenaceae Gürke				
146	*Diospyros lotus* L.	EN	B1b(i,ii,iii,iv, v) + 2b(i,ii, iii,iv,v).	2.1,5.2
Euphorbiaceae Juss.				
147	*Euphorbia densiuscula* Popov	EN	B1b(i,ii,iii,iv, v) + 2a,b(iii).	2.3,2.1,3.2
148	*Euphorbia densiusculiformis* (Pazij) Botsch.	EN	B1b(i,iii) + 2a,b(iii).	2.3,2.1,3.2
149	*Euphorbia kudrjaschevii* (Pazij) Prokh.	**DD**		12.1
150	*Euphorbia triodonta* Prokh.	EN	B1ab(iii) + 2ab(iii).	2.3,3.1
Fabaceae Lindl.				
151	*Astragalus abolinii* Popov	EN	B1a,b(ii,iii, iv) + B2a,b (ii,iii,iv).	12.1, 1.3, 6.1
152	*Astragalus adylovii* F.O. Khass., Ergashev & Kadyrov	CR	B1ab(i,ii,iii, iv,v) + 2ab(i, ii,iii,iv,v); C2a(i,ii);D1.	2.3,3.2,3.3
153	*Astragalus alexeji* Gontsch.	DD		12.1

(*continued on next page*)

Table 2 (*continued*)

N°	Taxon	IUCN Red List category	IUCN Red List Criteria	IUCN Threats ID
154	*Astragalus auratus* Gontsch.	EN	B1ab(ii,iii,iv,v) + 2ab(ii,iii,iv,v).	2.3, 1.3, 6.1
155	*Astragalus austroferganicus* Kamelin & V.M.Vinogr.	EN	B1ab(i) + 2abc(ii,iii,iv).	2.3,2.1
156	*Astragalus baranovii* Popov	DD		10.3, 12.1
157	*Astragalus belolipovii Kamelin*	CR	B1b(i,iii) + 2a,b(ii,iii); C2a(i);D1.	12.1
158	*Astragalus borissianus* Gontsch.	DD		1.3, 6.1
159	*Astragalus bucharicus* Regel	EN	B2a,b(ii,iii,iv,v).	2.3
160	*Astragalus butkovii* Popov	CR	B1ab(i,iii) + 2ab(ii,iii)	12.1
161	*Astragalus centralis* E. Sheld.	CR	B1ab(i,ii,iii,v).	2.3,3.2,1.2
162	*Astragalus dianthoides* Boriss.	EN	B1ab(ii,iii,iv) + 2ab(ii,iii,iv).	2.3,2.1
163	*Astragalus holargyreus* Bunge	EN	B1b(ii,iii) + 2b(i,ii,iii,iv); C1.	2.3,3.2
164	*Astragalus knorringianus* Boriss.	VU	B1ab(ii,iii,iv,v) + 2ab(ii,iii,iv).	2.3
165	*Astragalus komarovii* Lipsky	EN	B1ab(i,ii,iii,iv,v) + 2ab(i,ii,iii,iv);C2a(i).	2.3
166	*Astragalus kuldzhuktauense* F.O. Khass., Shomur. & Esankulov	EN	B1b(i,iii,iv) + 2ab(ii,iii,iv,v);C1a(1).	2.3,3.2,3.3
167	*Astragalus lasiocalyx* Gontsch.	VU	B1a,b(ii,iii) + B2a,b(ii,iii).	2.3, 1.3, 6.1
168	*Astragalus leptophysus* Vved.	EN	B1b(ii,iii,iv) + 2b(ii,iii,iv).	2.3,3.2
169	*Astragalus massagetovii* B. Fedtsch.	**DD**		2.3,10.3,12.1
170	*Astragalus michaelis* Boriss.	**DD**		12.1
171	*Astragalus namanganicus* Popov	EN	B1ab(i,iii) + 2ab(ii,iv); C2a(i).	2.3, 1.3, 6.1
172	*Astragalus nucleosus* Popov	DD		2.3,2.1
173	*Astragalus nuratensis* Popov	EN	B1b(i,iii) + 2b(ii,iv);C2a(i).	2.3, 1.3, 6.1
174	*Astragalus plumatus* Boriss.	EN	B1ab(ii,iii,iv,v) + 2ab(ii,iii,iv,v); C2a(i).	2.3,3.2,1.2, 1.3, 6.1
175	*Astragalus plumbeus* (Nevski) Gontsch.	DD		12.1
176	*Astragalus pseudanthylloides* Gontsch.	EN	B1ab(I,iii,v) + 2ab(ii,iii,iv);C2a(i).	2.3,3.2
177	*Astragalus pseudoeremophysa* Popov	EN	B1ab(I,ii,iii,v) + 2ab(I,ii,iv);C2a(I,ii).	2.3,2.1
178	*Astragalus pskemensis* Popov	EN	B1a,b(iii) + 2a,b(iii);C2a(i).	2.3,10.3, 1.3, 6.1
179	*Astragalus rhacodes* Bunge	CR	B1ab(ii,iii,iv) + 2ab(ii,iii,iv);C1a(i).	2.3,1.2
180	*Astragalus rubellus* Gontsch.	EN	B1ab(I,iii,iv) + 2b(ii,iii,iv);C2a(i).	2.3,2.1
181	*Astragalus rubrigalli* Popov	CR	B1ab(ii,iii,iv) + c(iv) + 2ab(ii,iii,iv)	2.3,12.1
182	*Astragalus rubrivenosus* Gonsch.	EN	B1ab (ii,iii,iv,v) + 2ab (ii,iii,iv,v).	2.3,12.1, 1.3, 6.1
183	*Astragalus spryginii* Popov	EN	B1ab(i,iv) + 2ab(ii,iii).	2.3,2.1
184	*Astragalus subschachimardanus* Popov	CR	B1b(I,iii) + 2ab(iii); D1.	12.1
185	*Astragalus terrae-rubrae* Butkov	EN	B1ab(iii) + 2ab(iii).	2.3
186	*Astragalus tupalangi* Gontsch.	DD		2.3
187	*Astragalus willisii* Popov	EN	B1ab(i,iii,iv) + 2ab(ii,iii,iv);C1a(i).	
188	*Calispepla aegacanthoides* Vved.	EN	B2ab (I, ii, iii, iv, v); C1.	2.3,2.1
189	*Calophaca reticulata* Sumnev.	CR	B1ab(iii) + 2ab(iii).	2.3,2.1
190	*Cercis griffithii* Boiss.	EN	B1a,b(I,ii,iii,iv,v) + 2a,b(I,ii,iii,iv,v); C1a(i).	5.3
191	*Chesneya tribuloides* Nevski	EN	B1a,b(I,ii,iii,v) + 2ab (I,ii,iv);C2a(I,ii).	2.3
192	*Cicer grande* (Popov) Korotkova	EN	B1b(i,iii,iv,v) + 2ab(ii,iii,iv,v).	2.3,3.2
193	*Cicer incanum* Korotkova	CR	B1a,b(ii,iii,iv) + 2a,b(ii,iii,iv).	2.3
194	*Eremosparton flaccidum* Litv.	EN	B2ab(i,ii,iii,iv,v);C1a(i).	2.3,3.2,5.3
195	*Eversmannia botschanzevii* Sarkisova	DD		2.3
196	*Hedysarum amankutanicum* B.Fedtsch.	DD		2.3
197	*Hedysarum angrenicum* Korotkova	DD		12.1
198	*Hedysarum bucharicum* B. Fedtsch.	EN	B1ab(I,iii) + 2ab(ii,iii,iv).	2.3
199	*Hedysarum drobovii* Korotkova	CR	B1ab(I,ii,iii,iv,v) + B2ab(I,ii,iii,iv,v); C2a(i).	2.3,1.2
200	*Hedysarum magnificum* Kudr.	VU	B2a,b(iii).	2.3
201	*Onobrychis tavernierifolia* Stocks ex Boiss.	EN	B1b(i,iii,iv,v) + 2b(ii,iii,iv,v).	2.3,3.2
202	*Oxytropis fedtschenkoana* Vassilcz.	EN	B1a,b(I,iii) + 2a,b(ii,iii).	12.1
203	*Oxytropis kamelinii* Vassilcz.	CR	B1ab(I,iv, v) + 2ab(ii,iii).	2.3
204	*Oxytropis maidantalensis B. Fedtsch.*	EN	B1ab(I,iii) + 2b(ii,iii).	12.1
205	*Oxytropis pseudoleptophysa* Boriss.	EN	B1ab(I,iii) + 2ab(ii,iii).	12.1
206	*Oxytropis pseudorosea* Filim.	EN	B1ab(I,ii,iii,iv,v) + 2ab(I,ii,iii,iv,v).	2.3,3.2
207	*Oxytropis tyttantha* Gontsch.	EN	B1ab(I,ii) + 2ab(I,ii).	2.3
208	*Oxytropis vvedenskyi* Filim.	EN	B1b(I,iii) + 2b(ii,iii).	2.3
	Fumariaceae Marquis			
209	*Fumariola turkestanica* Korsh.	CR	C2a(i) + D1.	2.3, 1.3, 6.1

(*continued on next page*)

Table 2 (*continued*)

N°	Taxon	IUCN Red List category	IUCN Red List Criteria	IUCN Threats ID
Grossulariaceae DC.				
210	*Ribes malvifolium* Pojark.	EN	B1b(iii) + 2ab(iii);C2a (i).	2.3
Hyacinthaceae Batsch ex Borkh.				
211	*Dipcadi turkestanicum* Vved.	EX		2.3,2.1
Iridaceae Juss.				
212	*Gladiolus italicus* Mill.	VU	B1b(i,iii,v) + 2b(ii,iii).	2.3,2.1,5.2
213	*Iris austrotschatkalica* Tojibaev, F.Karimov & Turgunov	CR	B1ab(i,iii,iv, v) + 2ab(ii, iii,v);C2a(ii).	2.3,1.2
214	*Iris magnifica* Vved.	VU	B1ab(iii) + 2ab(iii); C2a (i).	2.3, 1.3, 6.1
215	*Iris orchioides* Carrière	NT		2.3, 1.3, 6.1
216	*Iris hippolyti* (Vved.) Kamelin	EN	B1b(iii,v) + 2b(iii,v) + D.	2.3, 1.3, 6.1
217	*Iris svetlanae* (Vved.) T. Hall & Seisums	VU	B1ab(iii) + 2ab(iii);C2a (i).	2.3, 1.3, 6.1
218	*Iris winkleri* Regel	DD		12.1
219	*Iris victoris* F.O. Khass., Khuzhan. & Rakhimova	EN	B1b(i,ii,iii,iv, v) + 2b(i,ii, iii,iv,v).	12.1
Lamiaceae Martinov				
220	*Dracocephalum adylovii* I.I. Malzev	EN	B1a,b(iii) + 2a,b(iii).	10.3,12.1
221	*Dracocephalum formosum* Gontsch.	EN	B1b(I,iii) + 2b(ii,iii);C1 a (i) + 2a(i).	12.1
222	*Dracocephalum komarovii* Lipsky	VU	B2b(iii,v); C1a(i).	2.3
223	*Dracocephalum spinulosum* Popov	EN	B1b(i,iii,iv) + 2b(ii,iii); C2a(ii).	12.1
224	*Eremostachys eriolarynx* Pazij & Vved.	EN	B1ab(I,ii,iii, iv) + 2ab(ii, iii,iv).	2.3
225	*Lagochilus inebrians* Bunge	VU	B2b(i,ii,iii,iv, v);C1.	2.3,3.2,3.3,5.2
226	*Lagochilus olgae* Kamelin	EN	B1b(iii) + 2b (iii);C2a(i).	2.3,12.1, 1.3, 6.1
227	*Lagochilus proskorjakovii* Ikramov	EN	B1ab(ii,iii) + 2ab(ii,iii); C2a(i).	2.3,3.2, 1.3, 6.1
228	*Lagochilus vvedenskyi* Kamelin & Tzukerv.	EN	B2b(ii,iii); C1.	2.3,3.2,3.3
229	*Moluccella bucharica* (B. Fedtsch.) Ryding	CR	A2(a,c); B1ab (I,ii,iii,iv,v).	2.3,5.3
230	*Moluccella fedtschenkoana* (Kudr.) Ryding	EN	B1b(ii,iii,iv) + 2b(ii,iii, iv);C1a(i,ii) + 2a(i,ii).	2.3
231	*Moluccella sogdiana* (Kudr.) Ryding	EN	B1b(ii,iii,iv) + 2b(ii,iii, iv);C1a(I,ii).	2.1
232	*Phlomidoschema parviflorum* (Benth.) Vved.	DD		2.3
233	*Phlomis nubilans* Zakirov	NT		2.3,2.1,3.2
234	*Phlomoides anisochila* (Pazij & Vved.) Salmaki	EN	B1b,c(ii,iii, iv) + 2b,c(ii, iii,iv); C2a(*i*) b.	2.3,3.2
235	*Phlomoides aralensis* (Bunge) Salmaki	EN	B2ab(ii,iii, iv).	2.3,1.2
236	*Phlomoides baburii* (Adylov) Adylov	DD		2.3
237	*Phlomoides gypsacea* (Popov) Adylov, Kamelin & Makhm.	DD		12.1
238	*Phlomoides kirghisorum* Adylov, Kamelin & Makhm.	EN	B1ab(ii,iii) + 2ab(ii,iii,iv); C1.	2.3,2.1
239	*Phlomoides leiocalyx* (Pazij & Vved.) Adylov, Kamelin & Makhm.	DD		2.3
240	*Phlomoides michaelis* Adylov, Kamelin & Makhm.	EN	B1ab(I,ii,iii, iv) + 2ab(I,ii, iii,iv); C2a (i).	1.2
241	*Phlomoides pulchra* (Popov) Adylov, Kamelin & Makhm.	EN	B1ab(ii,iii, iv) + 2ab(iii, iv); C2a(i).	2.3, 1.3, 6.1
242	*Phlomoides transoxana* (Bunge) Salmaki	EN	B2ab(ii,iii, iv).	2.3,1.2
243	*Phlomoides tschimganica* (Vved.) Adylov, Kamelin & Makhm.	DD		12.1
244	*Salvia insigins* Kudr.	EN	B12a,b(iii) + 2a,b(iii);C1.	2.3
245	*Salvia korolkowii* Regel & Schmalh.	VU	B1b(I,iii) + 2b(ii,iii).	12.1
246	*Salvia lilacinocaerulea* Nevski	VU	B1b(I,ii,iii,v) + 2b(ii,iii, iv,).	2.3,2.1
247	*Salvia margaritae* Botsch.	EN	B1ab(I,iii,iv) + 2ab(iii).	2.3
248	*Salvia submutica* Botsch. & Vved.	EN	B1ab(ii,iii, iv) + 2ab(ii, iii,iv);C2a(i).	2.3,3.2
249	*Salvia tianschanica* Makhm.	EN	B1ab(iii) + 2ab(iii).	12.1
250	*Scutellaria colpodea* Nevski	EN	B1ab(I,ii,iii, iv,v) + 2ab(I, ii,iii,iv,v).	2.3
251	*Scutellaria fedtschenkoi* Bornm.	EN	B1ab(iii) + 2ab(iii);C2a (i).	12.1
252	*Scutellaria guttata* Nevski ex Juz.	EN	B1abc(i) + 2abc(ii,iii, iv).	2.3
253	*Scutellaria holosericea* Gontsch. Ex Juz.	CR	B1ab(ii,iii, iv).	12.1
254	*Scutellaria villosissima* Gontsch. Ex Juz.	CR	B1ab(ii,iii, iv).	12.1
Liliaceae Juss.				
255	*Fritillaria eduardii* Regel	EN	B2ab(i,ii,iii, v).	5.2
256	*Gagea ludmilae* Levichev	DD		2.1
257	*Tulipa affinis* Botschantz.	VU	B1a,b(ii,iii, iv).	2.3
258	*Tulipa borszczowii* Regel	VU	B2b(ii,iii,iv, v);C2a(i).	2.3,2.1, 1.3, 6.1
259	*Tulipa butkovii* Botschantz.	VU	B1ab(i,ii,iii, v) + 2ab(i,ii, iii,v).	2.3, 1.3, 6.1
260	*Tulipa carinata* Vved.	EN	B1ab(ii,iii, iv) + 2ab(ii, iii,iv).	2.3,2.1
261	*Tulipa dubia* Vved.	VU	B1b(ii,iii,v) + 2b(ii,iii,v).	2.3
262	*Tulipa ferganica* Vved.	VU	B2ab(ii,iii, iv).	2.3,2.1
263	*Tulipa fosteriana* Irving	EN	B2ab(i,ii,iv).	2.3,5.2
264	*Tulipa greigii* Regel	VU	B1ab(i,ii,iii).	2.3,2.1

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Table 2 (*continued*)

N°	Taxon	IUCN Red List category	IUCN Red List Criteria	IUCN Threats ID
265	*Tulipa ingens* T.M.Hoog	VU	B1b(ii,iii,iv, v) + 2b(ii,iii, iv,v).	2.3,2.1
266	*Tulipa kaufmanniana* Regel	VU	B2ab(i,ii,iii, v).	2.3,5.2
267	*Tulipa korolkowii* Regel (*Tulipa intermedia* Tojibaev & J. de Groot)	VU	B1b(i,iii,iv) + 2b(ii,iii, iv).	2.3,2.1
268	*Tulipa lanata* Regel	VU	B1b(i,iii,iv, v) + 2ab(ii, iii,iv,v).	2.3,2.1
269	*Tulipa lehmanniana* Merckl.	NT		2.3,5.2
270	*Tulipa micheliana* T.M. Hoog	VU	A4ac;B2ab (ii,iii,iv).	2.3,2.1
271	*Tulipa orithyioides* Vved.	EN	B1ab(iii,v) + 2ab(iii,v).	2.3
272	*Tulipa scharipovii* Tojibaev	EN	B1ab(i,ii,iii, iv,v) + 2ab(i, ii,iii,iv,v).	2.3,2.1
273	*Tulipa tubergeniana* T.M. Hoog	VU	B2ab(ii,iii,v).	2.3,2.1
274	*Tulipa uzbekistanica* Botschantz. & Sharipov	CR	B1ab(iii).	2.3
275	*Tulipa vvedenskyi* Botschantz.	EN	A4ac; B1b(ii, iii,iv,v) + 2b (ii,iii,iv,v).	2.3,5.2
Moraceae Gaudich.				
276	*Ficus carica* L.	EN	B1,b(i,ii) + 2, b(ii,iii,iv).	5.3
Nitrariaceae Lindl.				
277	*Malacocarpus crithmifolius* (Retz.) C.A.Mey.	VU	A2c; B2b(ii, iii);D1 + D2.	10.3
Orchidaceae Juss.				
278	*Eulophia turkestanica* (Litv.) Schlecht. (*Eulophia dabia* (D.Don) Hochr)	DD		10.3
Phyllanthaceae Martinov				
279	*Andrachne vvedenskyi* Pazij	DD		2.3,2.1,3.1
Platanaceae T.Lestib.				
280	*Platanus orientalis* L.	VU	B1b(i,iii,iv, v) + 2b(ii,iii, iv,v).	2.1,5.3
Plumbaginaceae Juss.				
281	*Acantholimon annae* Lincz.	CR	B1ab(ii,iii,iv, v);C2a(i).	2.3,2.1
282	*Acantholimon ekatherinae* (B.Fedtsch.) Czerniak.	EN	B1a,b(i,iii) + B2a,b(ii, iii);C2a(i).	2.3,12.1, 1.3, 6.1
283	*Acantholimon margaritae* Korovin ex Lincz.	EN	B1ab(i,iii) + 2ab(ii,iii); C2a(i).	2.3, 1.3, 6.1
284	*Acantholimon nuratavicum* Zakirov ex Lincz.	EN	B1a,b(ii,iii) + 2a,b(ii,iii).	2.3,2.1
285	*Acantholimon subavenaceum* Lincz.	EN	B1ab(ii,iii) + 2ab(ii,iii); C2a(i).	2.3,2.1
286	*Acantholimon zakirovii* Beshko	EN	B1ab(ii,iii) + 2ab(ii,iii); C2a(i).	2.3,2.1
287	*Cephalorhizum oopodum* Popov & Korovin	EN	B1b(i, iii) + 2ab(ii,iii,iv, v).	2.3,2.1

Table 2 (*continued*)

N°	Taxon	IUCN Red List category	IUCN Red List Criteria	IUCN Threats ID
Poaceae Barnhart				
288	*Stipa aktauensis* Roshev.	EN	B2ab(I,ii,iii, iv).	2.3,2.1
289	*Stipa gnezdilloi* Pazij	DD		12.1
290	*Stipa karataviensis* Roshev.	**DD**		12.1
Polygonaceae Juss.				
291	*Calligonum elegans* Drobow	EN	B1ab(ii,iii, iv) + 2ab(iii, iv).	2.3
292	*Calligonum matteianum* Drobow	CR	C1a(i) + 2a(i, ii).	3.2,3.1,3.3
293	*Calligonum molle* Litv.	CR	B1ab(ii,iii,iv, v) + 2ab(ii, iii,iv,v);C2a (i,ii);D1.	3.2,3.1,3.3
294	*Calligonum* × *calcareum* Pavlov	EN	B1b(i,ii,iii,v) + 2b(ii,iii).	2.3,2.1
295	*Calligonum x paletzkianum* Litv.	EN	B2ab(i,ii,iii, iv,v);C2a(i, ii).	3.2,3.1,3.3
Primulaceae Batsch ex Borkh.				
296	*Dionysia hissarica* Lipsky	VU	B1ab(I,iii,v) + 2ab(ii,iii, v);C1a(i).	12.1
Lythraceae J.St.-Hil.				
297	*Punica granatum* L.	EN	B1b(i,ii,iii, iv) + 2b(i,ii, iii,v).	2.3
Ranunculaceae Juss.				
298	*Aconitum talassicum* Popov	NT		1.3, 6.1
299	*Anemone baissunensis* Juz.	EN	B2b(ii,iii).	2.3
300	*Anemone bucharica* Regel	EN	B1b(i,iii,iv, v) + 2b(ii,iii, iv,v)**.**	2.3
301	*Delphinium knorringianum* B.Fedtsch.	**CR**	B1ab(i,ii,iii, iv,v) + 2ab(i, ii,iii,iv,v); C2a(i);D1**.**	2.3,2.1
Rhamnaceae Juss.				
302	*Rhamnus erythroxyloides* subsp. *sintenisii* (Rech.f.) Mabb.	EN	B2ab(ii,iii, iv);C1a(i).	2.3,3.2,5.3
303	*Ziziphus jujuba* Mill.	EN	B2ab(ii,iii).	5.2,5.3
Rosaceae Juss.				
304	*Pyrus asia-mediae* (Popov) Maleev	DD		12.1
Rubiaceae Juss.				
305	*Plocama alshehbazii* F.O. Khass., Khamraeva, Khuzhan. & Achilova	DD		2.3
306	*Plocama botschantzevii* (Lincz.) M.Backlund & Thulin	EN	B1b(i,iii,iv) + 2b(ii,iii).	2.3,2.1
307	*Rubia laevissima* Tscherneva	EN	B1b(i,iii) + 2b(ii,iii);C2a (i).	10.3, 1.3, 6.1
Rutaceae Juss.				
308	***Haplophyllum bucharicum* Litv.**	EN	B1b(i,iii) + 2b(ii,iii).	2.3,2.1

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Table 2 (*continued*)

N°	Taxon	IUCN Red List category	IUCN Red List Criteria	IUCN Threats ID
Santalaceae R.Br.				
309	*Thesium minkwitzianum* B. Fedtsch.	CR	B1ab(i,ii,iii, iv,v) + 2ab(i, ii,iii,iv,v); C2a(i).	12.1
Saxifragaceae Juss.				
310	*Bergenia hissarica* Boriss.	EN	B1ab(iii).	2.3
311	*Bergenia ugamica* V.N. Pavlov	EN	B1a,b(i,iii) + 2a,b(ii,iii).	2.3,5.2,10.3
Scrophulariaceae Juss.				
312	*Pedicularis grandis* Popov ex Vved.	CR	B1ab(i,iii,v) + 2ab(ii,iii, v);C1a(i,ii) + 2a(i,ii);D1.	2.3
313	*Triaenophora bucharica* B. Fedtsch.	EN	A4(ac) + B1b (i,ii,iii,iv,v), c(iv)-2b(i,ii, iii,iv,v), c(iv) + E.	2.3,3.2,3.1
Solanaceae Juss.				
314	*Physochlaina alaica* Korotkova	CR	B1ab(i,iii,iv) + 2ab(ii,iii, iv).	2.3
Thymelaeaceae Juss.				
315	*Restella alberti* (Regel) Pobed.	VU	B2b(ii,iii).	2.3
Vitaceae Juss.				
316	*Vitis vinifera* L.	VU	B2ab(i,ii,iii, iv,v).	2.3
Zygophyllaceae R.Br.				
317	*Zygophyllum bucharicum* B. Fedtsch.	CR	B1ab(i,ii,iii, iv,v) + 2ab(i, ii,iii,iv,v); C1a(ii) + 2a (i,ii);D1.	2.3

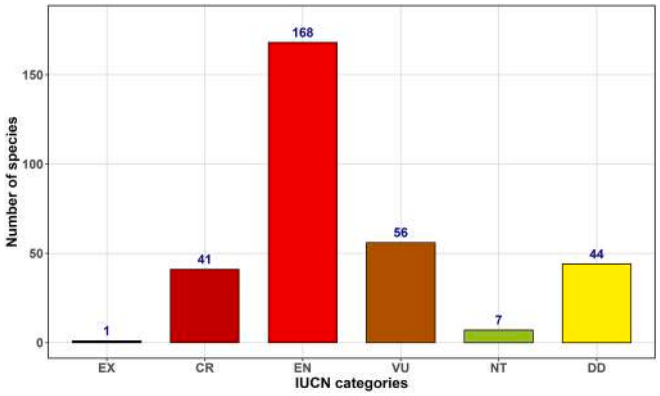

Fig. 5. Distribution of threatened species by IUCN categories. Abbreviations: EX = Extinct; CR = Critically Endangered; EN = Endangered; VU = Vulnerable; NT = Near Threatened; DD = Data Deficient.

population density. Populations of threatened species are also significantly impacted by the collection of plants for medicinal and food purposes, bouquet making, and use as fuelwood. This factor contributes to the decline of 41 threatened species. Additionally, the development of renewable energy infrastructure (construction of wind and solar power plants) and the conduct of geological exploration activities also affect the status of rare and endangered species populations to varying degrees.

4. Discussion

4.1. Taxonomic structure and degree of endemism of threatened species

The threatened flora of Uzbekistan exhibits pronounced taxonomic and biogeographic patterns. The predominance of representatives of the families Fabaceae, Asteraceae, Lamiaceae, and Apiaceae reflects both the high overall species richness of these taxa in the arid and mountainous ecosystems of Central Asia and their increased vulnerability to contemporary anthropogenic and natural factors (Khabibullaev et al., 2026). Moreover, this distribution pattern generally corresponds to the spectrum of leading families and genera of strict national endemics in Uzbekistan, where the top five families include Asteraceae, Fabaceae, Lamiaceae, Amaryllidaceae, and Apiaceae, and the leading genera are *Astragalus*, *Cousinia*, *Allium*, *Silene*, and *Phlomoides* (Turginov, 2025).

A comparison of taxa included in the national Red Data Books of Central Asian countries also reveals similarities in the composition of dominant families and genera. In the Red Data Book of Kazakhstan, representatives of the families Asteraceae, Fabaceae, Apiaceae, Liliaceae, and Brassicaceae prevail, with leading genera including *Tulipa*, *Astragalus*, *Allium*, *Oxytropis*, and *Ferula* (Baitulin, 2014). In the Red Data Book of Tajikistan, species of the families Fabaceae, Apiaceae, Liliaceae, Asteraceae, and Alliaceae (= Amaryllidaceae) dominate, with the greatest number of species belonging to the genera *Allium*, *Tulipa*, *Ferula*, *Eremurus*, and *Cousinia* (Hisoriev, 2017). In the Red Data Books of Turkmenistan and Kyrgyzstan, the family Rosaceae is also among the top five due to the high number of threatened species within the genera *Pyrus*, *Sorbus*, and *Malus*, while in Turkmenistan the family Orchidaceae is additionally notable, represented by eight species (Saparmuradov, 2024; Davletkeldiev, 2006). These findings confirm that plant diversity in Central Asia is largely structured around representatives of the families Asteraceae, Fabaceae, Lamiaceae, Apiaceae, Amaryllidaceae, and Brassicaceae, within which a substantial proportion of endemic species is concentrated, most of which require conservation measures.

A particularly important finding is the high proportion of endemic species of the genus *Astragalus,* one of the most polymorphic genera of the flora of Uzbekistan (Tojibaev et al., 2015; Khabibullaev et al., 2026), recommended for inclusion in the latest edition of the RDBUz, confirming its role as one of the key centers of speciation in the region. The concentration of narrow-range endemics within a single genus indicates a high degree of ecological specialization and, consequently, a strong sensitivity to environmental changes. Similar patterns, although to a lesser extent, are observed in the genera *Oxytropis* and *Hedysarum*, highlighting the importance of Fabaceae in shaping the unique floristic core of the region.

The high diversity of threatened species in the genera *Cousinia*, *Jurinea*, *Phlomoides*, *Salvia*, and *Scutellaria* reflects their association with mountain ecosystems characterized by high habitat heterogeneity and population isolation. These conditions promote active microevolutionary processes and the formation of endemism, but at the same time increase the risk of species extinction when habitats are disturbed.

Species of the genus *Ferula* are characterized by a combination of high regional endemism and intensive economic use, which increases anthropogenic pressure on their natural populations. In addition, these species exhibit monocarpic life cycles and long juvenile phases prior to flowering, which further increases their vulnerability to environmental and anthropogenic impacts. This makes the genus one of the priority targets for the development of conservation and sustainable use strategies.

The genus *Tulipa* deserves special attention, as its main limiting

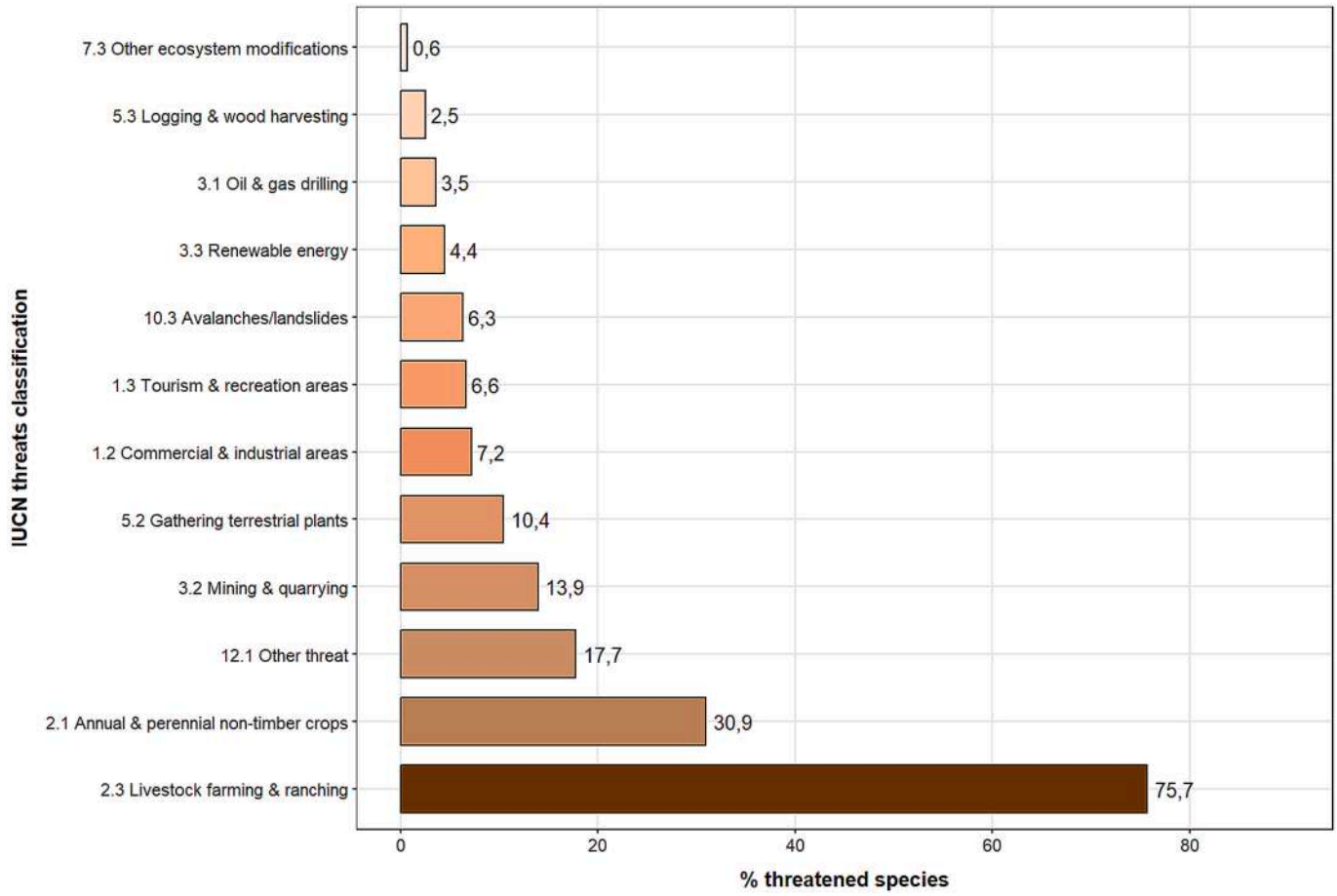

Fig. 6. Percentage of vascular plants of Uzbekistan affected by the major threat category according to the IUCN classification Scheme (version 3.3; https://www.iucnredlist.org/resources/threat-classification-scheme).

factor is direct anthropogenic impact, primarily the mass collection of flowering plants. The long-term inclusion of a large number of *Tulipa* species in the RDBUz confirms the persistent nature of this threat and the insufficient effectiveness of existing conservation measures. At the same time, the exclusion of certain desert species from protection lists demonstrates that population recovery is possible under favorable conditions, particularly for species with broader ecological amplitudes. Thus, *T. sogdiana, T. buhseana,* and *T. turkestanica*, mainly confined to desert ecosystems, were removed from the protection lists due to the recovery of their populations and consistently high abundance. Overall, the substantial number of *Tulipa* species already included in the first edition of the RDBUz indicates the high vulnerability of natural populations of this genus within the country.

An analysis of changes in the taxonomic composition and status of vulnerable species across editions of the RDBUz reveals several important trends. The overall increase in the number of protected species over time reflects both the accumulation of knowledge about the country's flora and the intensification of anthropogenic pressure on natural ecosystems. The exclusion of certain species in subsequent editions, due to population recovery or the discovery of new local populations, indicates that conservation measures can be effective under favorable conditions. At the same time, the addition of a significant number of newly recognized rare or threatened species highlights the continuing vulnerability of Uzbekistan's flora and the need for regular reassessment of its status. Observed changes in conservation categories for some taxa further demonstrate that population status is dynamic and responds to both natural and human-induced changes.

Overall, the identified patterns confirm that the current structure of the threatened flora of Uzbekistan is shaped by a combination of endemism, ecological specialization, and anthropogenic pressure, which should be taken into account in setting conservation priorities and improving the RDBUz.

4.2. Distribution of threatened species across threat categories

Among all the species considered, only one species is classified as Extinct (EX): *Dipcadi turkestanicum* Vved. was described by A.I. Vvedensky in 1941 based on herbarium specimens collected in 1937 on the sands of the Khaudak Desert (southern Uzbekistan). The last known herbarium specimen of this species dates from 1958 and is housed in the TASH herbarium (Uzbekistan). Targeted field surveys conducted over the past 10 years to confirm the species' persistence in its natural habitats have been unsuccessful. Consequently, *D. turkestanicum* has been assessed as globally extinct, as this taxon is absent from both natural populations and botanical garden collections (Tojibaev et al., 2022).

The majority of species falls into the categories Endangered (168 species) and Vulnerable (56 species), followed by Critically Endangered (41 species, 26 of them endemics of Uzbekistan), indicating an extremely high risk of extinction. Within this group, particular attention is required for certain endemic species – *Allium botschantzevii* Kamelin, *Allium ravenii*, *Ferula pratovii* F.O. Khass. & I.I. Malzev, *Arctium haesitabundum* (Juz.) S. López, Romasch., Susanna & N. Garcia, *Cousinia hoplophylla* Tscherneva, *Cousinia pseudolanata* Popov ex Tscherneva, *Vicoa krasheninnikovii* Kamelin, *Lappula parvula* Nabiev & Zakirov, *Parrya tojibaevii* D.A. German & Madaminov, *Astragalus adylovii* F.O. Khass., Ergashev & Kadyrov, *Astragalus centralis* E. Sheld., *Astragalus rhacodes* Bunge, *Astragalus rubrigalli* Popov, *Calophaca reticulata* Sumnev., *Oxytropis kamelinii* Vassilcz., *Moluccella bucharica*, *Scutellaria villosissima*

Gontsch. & Juz., and *Tulipa uzbekistanica* Botschantz. & Sharipov—whose ranges are located outside the existing network of protected areas, which places them at high risk of extinction.

Of the 44 species classified as Data Deficient (DD), three species (*Oenanthe fedtschenkoana*, *Euphorbia kudrjaschevii*, and *Astragalus alexeji*) are also considered potentially extinct, as they are known only from a limited number of herbarium specimens collected between the 1870s and the 1930s. However, because targeted search surveys have been conducted only over the past two to three years and did not cover the full range of potentially suitable habitats, these species have been retained in the RDBUz under the category DD.

4.3. Major threats affecting the population status of threatened species

The main threats to plants in Uzbekistan are predominantly anthropogenic. The dominant factor is the unregulated livestock grazing, which affects the vast majority of species, indicating chronic overexploitation of pasture ecosystems, particularly in mountainous and foothill areas. This leads to habitat degradation, reduced regenerative capacity of populations, and increased fragmentation.

The decline in population sizes of 75.7% of plant species recommended for inclusion in the new edition of the RDBUz is associated with the impact of this threat. As a primary source of income for rural communities, livestock farming places a significant burden on natural ecosystems. The number of small ruminants in the mountainous and foothill regions of the country exceeds the carrying capacity of pastures several times over; as expected, in arid desert areas (the Kyzylkum Desert and the Ustyurt Plateau), livestock numbers are considerably lower due to the limited availability of water resources.

Land conversion for agriculture and the harvesting of plants from natural populations also play a significant role, which is especially characteristic of densely populated lowland areas. These processes reflect the ongoing conflict between economic land use and biodiversity conservation objectives.

Less pronounced but still significant threats, including mining activities, infrastructure development (including renewable energy facilities), and recreational pressure, create additional stress on vulnerable species. Although their overall share is comparatively smaller, their impact can be locally critical, particularly in areas with a high concentration of endemics.

Thus, the presented data confirm that effective conservation of threatened species requires a comprehensive approach, including regulation of grazing pressure, monitoring of land conversion, and integration of conservation requirements in the implementation of infrastructure projects.

4.4. Extent of protected area coverage of threatened species populations

The data presented indicate the high representativeness of the existing protected area network with respect to floristic diversity in the Southwestern Tien Shan Mountain system (within Uzbekistan) and adjacent territories, despite its spatial fragmentation and uneven distribution of protected ecosystems.

An analysis of the spatial distribution of species recommended for inclusion in the RDBUz shows that, out of 317 rare and threatened species, 175 (55%) occur outside protected areas in this region. At the same time, populations of 142 species are protected to varying degrees—either fully or partially. Notably, nearly half of these (74 species) are represented within the protected areas of the Southwestern Tien Shan, highlighting the key role of this region in the conservation of rare and endemic components of the national flora.

The Pamir-Alay mountain system within Uzbekistan represents the principal center of national endemism counting at least 190 species mainly localized in the Western Hissar Mountains, which constitute one of the main hotspots of endemism.

Overall, of the 228 species recommended for inclusion in the latest edition of the Red Data Book and occurring within the Pamir-Alay (151 of which are national endemics), 169 species have been recorded within protected areas of this mountain system, emphasizing their fundamental role in the conservation of rare and endemic plant diversity.

The coverage of rare and endangered species by existing protected areas located in the lowland regions is limited. Thus, within the Uzbek part of the Ustyurt Plateau, only certain populations of *Crambe edentula* Fisch. & C.A.Mey. ex Korsh., *Xylosalsola chiwensis* (Popov) Akhani & Roalson, and *Malacocarpus crithmifolius* (Retz.) C.A.Mey. are under protection. At the same time, populations of the widely distributed *Cynomorium coccineum* subsp. *songaricum* (Rupr.) J. Léonard, as well as strict national endemics – *Climacoptera ptiloptera* U.P. Pratov, *Scorzonera bungei* Krasch. & Lipsch., *Acanthophyllum krascheninnikovii* Schischk., and the sole critically rare endemic of the Ustyurt Plateau, *Allium ravenii* F.O.Khass., Shomur. & Kadyrov – are not protected in any of the existing PNTs.

An even more unfavorable situation exists for rare and threatened species occurring in the Kyzylkum Desert. Of the 29 species recommended for inclusion in the RDBUz, only certain populations of *Eremosparton flaccidum* Litv. and *Tulipa lehmanniana* Merckl. are protected within the Kyzylkum State Reserve. Three species of the genus *Calligonum* (*C. matteianum* Drobov, *C. molle* Litv., *C. paletzkianum* Litv.) are partially protected within the Dengizkul Ornithological Sanctuary, while two additional species with the widest ecological ranges—*Lagochilus inebrians* Bunge and *Tulipa micheliana* T.M. Hoog – occur within the boundaries of the Nuratau and Surkhan State Reserves.

All other threatened species, including strict endemics of Uzbekistan such as *Ferula kyzylkumica* Korovin, *Cousinia umbilicata* Juz., *Jurinea psammophila* Iljin, *Lappula aktaviensis* Popov & Zakirov, *Lepidium subcordatum* Botsch. & Vved., *Acanthophyllum cyrtostegium* Vved., *Silene tomentella* Schischk., *Astragalus kuldzhuktauense* F.O.Khass., Shomur. & Esankulov, *Astragalus adylovii* (a critically endangered species with fewer than 20 individuals), *Astragalus centralis*, *Eremostachys eriolarynx* Pazij & Vved., and *Phlomoides transoxana* (Bunge) Salmaki—are currently unprotected within any of the existing protected areas, which substantially increases the risk of their local or complete extinction.

In addition, the RDBUz includes eight species occurring within the Central Fergana (*Oenanthe fedtschenkoana*, *Astragalus rubellus* Gontsch., *Phlomoides michaelis* Adylov, Kamelin & Makhm., *Calligonum elegans* Drobov) and the Mirzachul Steppe (*Climacoptera malyginii* (Korovin ex Botsch.) Botsch., *Climacoptera merculowitschii* (Zokirov) Botsch., *Nonea calceolaris* Nikif. & Pazij, *Bryonia melanocarpa* Nabiev). All of these species occur outside protected areas and, accordingly, are not subject to territorial conservation measures. The only exception is *Astragalus rubellus*, whose populations are partially represented within the Yazyavan Nature Monument (Central Fergana). All of the listed species experience high levels of anthropogenic pressure from the transformation of natural landscapes, intensive land use, and habitat fragmentation, which substantially increase their vulnerability and the risk of further range contraction.

An analysis of the spatial distribution of species and subspecies recommended for inclusion in the RDBUz shows that, of the 317 rare and threatened taxa, 175 (55%) occur outside protected areas. At the same time, populations of 142 species are protected to varying degrees–either fully or partially. A comparison with data from the previous edition reveals that, somewhat paradoxically, the national system of protected areas has decreased the coverage of rare plant species by 2.1% at the present stage. This is because, of the 21 species recommended for exclusion from the RDBUz, 16 occurred within protected areas of the republic, whereas of the 24 species recommended for inclusion, only six are partially protected within protected areas (Supplementary Table S1).

4.5. Wider regional and global relevance of the findings

Although the present assessment is focused on Uzbekistan, several of

the patterns identified here are consistent with broader conservation challenges recognized across arid and semi-arid regions worldwide. The markedly lower protection of threatened species in the lowland deserts and intermountain depressions (the Kyzylkum Desert, the Ustyurt Plateau, Central Fergana, and the Mirzachul Steppe) relative to the mountain systems of the Southwestern Tien Shan and Pamir-Alay mirrors a well-documented global tendency of protected area networks to be biased toward higher elevations and terrain with lower land-conversion pressure, while lowland habitats — despite often harbouring high concentrations of narrow endemics — remain comparatively under-protected (Joppa and Pfaff, 2009; Elsen et al., 2018). This parallel suggests that the spatial gap-analysis approach applied here, linking IUCN Red List status to protected area coverage, could serve as a transferable, low-cost tool for identifying similar lowland conservation deficits in other floristically rich but data-limited drylands.

Similarly, the finding that unregulated livestock grazing underlies the population decline of 75.7% of the species assessed situates Uzbekistan within a much wider pattern documented across the world's rangelands. A recent global survey of 98 dryland sites on six continents showed that increasing grazing pressure is associated with declining ecosystem service delivery, including reduced plant diversity, particularly in warmer and already species-poor drylands (Maestre et al., 2022). The Central Asian evidence presented here adds a plant-conservation dimension to this global evidence base and reinforces calls for sustainable, regionally adapted grazing management as a conservation priority of comparable weight to habitat protection itself — a measure applicable to rangelands facing analogous pressures elsewhere.

Finally, the substantial overlap in dominant threatened families and genera among the Red Data Books of Uzbekistan, Kazakhstan, Tajikistan, Turkmenistan, and Kyrgyzstan (Section 4.1), together with a comparable IUCN-based assessment recently produced for neighboring Tajikistan (Nowak et al., 2020), underscores that Central Asian plant diversity — and the threats it faces — is fundamentally transboundary in character. Many narrow endemics and shared threat factors do not respect political borders, reinforcing the case for harmonized regional Red Listing criteria and coordinated conservation planning among Central Asian states. The assessment framework demonstrated here may equally inform conservation practice in other politically fragmented biodiversity hotspots where closely related floras are currently evaluated under inconsistent national systems.

5. Conclusion

The targeted assessment of vascular plant populations conducted in 2023–2025 enabled the development of a scientifically grounded, updated edition of the RDBUz, based on results from comprehensive taxonomic and field studies and the application of IUCN criteria. The sixth edition recommends 317 species, a substantial proportion of which (over 65%) are strict national endemics and Central Asian subendemics, highlighting Uzbekistan's significant regional responsibility for their conservation at both global and regional levels.

A critical analysis of nomenclature, refinement of species' ranges, and assessment of population dynamics enabled the exclusion of 21 species from the previous edition and the recommendation of 24 new taxa for inclusion. This outcome underscores the necessity of regularly revising national lists of rare species in light of current taxonomic knowledge and new field data. An analysis of the degree of protection for threatened species showed that more than half of rare and threatened species (55%) occur outside the existing network of protected areas. Despite the relative representativeness of protected areas in mountainous regions, lowland territories–particularly the Kyzylkum Desert, the Ustyurt Plateau, and the Fergana intermountain depression–exhibit a very low level of protection for populations of rare species. This is especially critical for narrowly distributed endemics and Critically Endangered species with small populations.

The main drivers of population decline and habitat degradation are unregulated livestock grazing, land conversion for agriculture, and the removal of plants from natural populations. Additional pressures arise from the development of energy infrastructure and geological exploration activities. The predominance of anthropogenic factors among the identified threat categories underscores the need to integrate plant conservation objectives into sustainable land-use strategies and regional planning.

The findings of the targeted assessment highlight several key implications for the conservation of Uzbekistan's rare and endemic plants. First, the pervasive impact of unregulated livestock grazing calls for the implementation of sustainable grazing management practices, particularly in mountainous and foothill regions where pressure on pasture ecosystems is highest.

Second, the low level of protection for populations in lowland areas–such as the Kyzylkum Desert, the Ustyurt Plateau, and the Fergana intermountain depression–indicates the need to expand and optimize the network of protected areas, with special attention to sites supporting narrowly distributed endemics and Critically Endangered species.

Third, land conversion for agriculture and plant extraction from natural populations should be carefully regulated, integrating conservation objectives into land-use planning and regional development strategies. In parallel, potential threats from infrastructure development and geological exploration should be mitigated through site-specific management and adherence to biodiversity safeguards.

Overall, these measures emphasize a holistic approach to plant conservation, combining habitat protection, sustainable resource use, and the integration of conservation priorities into national and regional planning. This approach will strengthen population viability, reduce fragmentation, and enhance the long-term resilience of Uzbekistan's vulnerable plant communities.

CRediT authorship contribution statement

Khabibullo Shomurodov: Writing – review & editing, Writing – original draft, Visualization, Validation, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Giuseppe Fenu:** Writing – review & editing, Writing – original draft, Supervision, Project administration, Investigation, Funding acquisition, Data curation. **Bekhruz Khabibullaev:** Writing – review & editing, Writing – original draft, Visualization, Validation, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Natalya Beshko:** Resources, Data curation. **Bekhzod Adilov:** Resources, Data curation. **Farkhod Karimov:** Resources, Data curation. **Orzimat Turginov:** Resources, Data curation. **Ozodbek Abduraimov:** Resources, Data curation. **Davron Dekhkonov:** Resources, Data curation. **Ulug'bek Kadirov:** Resources, Data curation. **Dilmurod Makhmudjanov:** Resources, Data curation. **Inom Juramurodov:** Resources, Data curation. **Azizbek Makhmudov:** Resources, Data curation. **Khusnidin Esanov:** Resources, Data curation. **Zokir Kosimov:** Resources, Data curation. **Akmal Allamuratov:** Resources, Data curation. **Feruz Akbarov:** Resources, Data curation. **Rustam Gulomov:** Resources, Data curation. **Hushbaht Hoshimov:** Resources, Data curation. **Akbar Akhmedov:** Resources, Data curation. **Shahnoza Saribaeva:** Resources, Data curation. **Nazokat Daminova:** Resources, Data curation. **Doston Turdiev:** Resources, Data curation. **Sardor Pulatov:** Resources, Data curation. **Khusniddin Abulfayzov:** Resources, Data curation. **Jasur Sadinov:** Resources, Data curation. **Jasurbek Isomov:** Resources, Data curation. **Kobiljon Fayziev:** Resources, Data curation. **Khikmatullo Ibragimov:** Resources, Data curation. **Komiljon Tojibaev:** Writing – review & editing, Writing – original draft, Visualization, Validation, Methodology, Investigation, Formal analysis, Data curation, Conceptualization.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.biocon.2026.112024.

Data availability

Data will be made available on request.

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