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ENDEMIC SPECIES OF THE FERGHANA VALLEY, DISTRIBUTED IN THE ANDIZHAN REGION, AND THEIR PROTECTION

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The mountainous and foothill zones of the Andijan region represent one of Uzbekistan’s most significant floristic areas, serving as a center of richness for rare, endemic, and ecologically sensitive plant species. This article presents the results of extensive field studies conducted between 2022 and 2025, during which 405 plant species occurring in the region were systematically identified. Their ecological status, geographic distribution, population dynamics, and threat levels were comprehensively analyzed.

Keywords: *Andijan region, IUCN criteria, endemic species, rare species, population, GeoCAT, threat levels*.

Горные и предгорные зоны Андижанской области являются одним из наиболее значимых флористических районов Узбекистана и центром разнообразия редких, эндемичных и экологически уязвимых видов растений. В статье представлены результаты полевых исследований 2022–2025 годов, в ходе которых выявлено 405 видов флоры региона. Проведён анализ их экологического состояния, географического распространения, динамики популяций и уровней угроз.

Ключевые слова*: Андижанская область, критерии МСОП, эндемичные виды, редкие виды, популяция, GeoCAT, уровни угроз.*

INTRODUCTION

One of the most pressing environmental issues facing humanity today is the ongoing decline in biodiversity. This process poses a serious threat to the stability of ecosystems on a global scale, leads to the loss of genetic resources, and jeopardizes both human health and economic well-being. In this context, identifying the world’s rare and endemic plant species and developing measures for their protection have become an integral part of ensuring ecological security and sustainable development [11. P. 82; 18. P. 30; 17. P. 13; 2. P. 1108] . In recent years, increasing anthropogenic transformation including land reclamation, expansion of industrial infrastructure, unregulated livestock grazing, and urbanization has placed significant pressure on natural ecosystems. As a result, the number of plant species is declining, and in some cases, entire species are at risk of extinction. This trend is particularly evident in areas with limited biological resources but high biodiversity, such as the foothill and mountainous regions of the Fergana Valley, specifically in Andijan Province [29. P. 91; 7. P. 355; 3. P. 49; 27]. In this context, studying the current status of rare and endemic plant species in Andijan Province including their natural-geographical distribution, ecological characteristics, population dynamics, and the identification of threatening factors as well as developing scientifically grounded conservation measures, holds significant scientific and practical importance [20. P. 118].

The mountainous and foothill regions of Andijan Province possess a unique and rich floristic diversity, where numerous endemic and rare plant species can be found. However, ongoing construction, infrastructure expansion, and other anthropogenic pressures, coupled with the rapid progression of synanthropization in the region, are leading to the degradation and shrinkage of the natural habitats of these species. This situation necessitates an in-depth study of the biological and ecological characteristics of these plants, as well as the development of effective conservation strategies [20. P. 119; 17. P. 16; 10. P. 8]. The importance of these issues is also increasingly

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reflected in national policy. In particular, the Presidential Decree of the Republic of Uzbekistan No. PF-5863, the Law of the Republic of Uzbekistan "On the Protection and Use of Plant World" [12], and the "Strategy for the Conservation of Biodiversity in the Republic of Uzbekistan for 2019–2028" clearly define the following priorities: "...to ensure the conservation and sustainable use of biodiversity, to develop and expand protected natural areas, to reduce the rate of degradation of natural ecosystems, and to restore rare and endangered species of flora and fauna" [9, 12, 13].

In line with these objectives, it is of vital scientific and practical relevance to assess the biodiversity of endemic species in Andijan Province, evaluate the influence of abiotic factors on their distribution, and develop conservation measures aimed at protecting rare, endemic, and threatened plant species [17. P. 20]. This scientific research directly contributes to the objectives outlined in the above-mentioned strategic documents by identifying endemic plant species in Andijan Province, conducting ecological and floristic analyses, and proposing effective conservation mechanisms. Therefore, the topic is considered highly relevant today—not only from a scientific and practical standpoint but also as an ecological necessity [16. P. 330; 7. P. 355; 6. P. 5].

Since the 1920s, botanical-geographical studies conducted in Uzbekistan have developed into a distinct scientific discipline, shaped by ecological, floristic-phylogenetic and phytocenological approaches. During this period, research in the Fergana Valley primarily focused on the classification and identification of economically significant plant species including medicinal plants as well as grasslands, mountain and foothill zones, foothills, and hayfields [19. P. 1065; 11. P. 82]. Expeditions organized by Russian scientists collected the first scientific data on the region's natural resources, soil types, vegetation composition, and fauna. These historical sources still serve as a valuable methodological foundation for current studies of the floristic diversity of the Fergana Valley, particularly in Andijan Province [23. P. 6; 21. P. 1111].

During the course of these studies, the scientific interest of geographers, geologists, and botanists in the plant world led to the collection of hundreds of herbarium specimens from the region. A portion of these specimens is currently preserved in the collections of the National Herbarium of Uzbekistan (TASH). The materials collected from the Fergana Valley and the present-day territory of Andijan Province between 1864 and 1930 are recognized as valuable scientific resources not only for Uzbekistan but also for researchers in neighboring Kyrgyzstan and Tajikistan [5. P. 75]. The historical stages of studying the natural flora of Andijan Province are marked by the expeditions and investigations of prominent Russian researchers such as A.P.Fedchenko and O.A.Fedchenko (1868–1871), G.I.Krauze (1870), A.Regel (1879), V.A.Nalivkin (1892–1893), S.I.Korzhinskiy (1892), B.A.Fedchenko (1903–1917), O.E.Knorring (1914–1915), Y.P.Korovin (1915–1916, 1928), Z.A.Minkwitz (1917), M.G.Popov (1922), V.P.Drobov (1925), M.V.Kultiasov (1926), A.V.Blagoveshchenskiy (1926), R.I.Abolin (1929), and M.M.Sovetkina (1929).

To date, the main research conducted in the territory of Andijan Province can be categorized into the following areas:

1. Studies on plant species distributed in ruderal biotopes;
2. Investigations of plant species occurring in urbanized environments;
3. Research on the impact of invasive species on biodiversity;
4. Studies related to vegetation cover analysis;
5. Scientific developments in the field of floristics.

In a study conducted by T.Kh. Makhkamov (2009), the current state of ruderal flora and vegetation cover in the Fergana Valley region of Uzbekistan was comprehensively examined. The research identified the taxonomic composition, distribution areas, and ecological characteristics of ruderal plant species. Notably, the initial investigations into the ruderal plant cover of Andijan Province were carried out by T.Makhkamov, whose work focused on ruderal species growing in synanthropic environments of the Fergana Valley. His research provided an in-depth analysis of the duration of vegetation periods, life forms, altitudinal zonation, geographical distribution, and various other indicators of plant species found in disturbed habitats. In a more recent study by N. Sidiqjanov (2024), the urban flora of Andijan City was thoroughly investigated. The research identified plant species distributed across various anthropogenically affected areas of the city. These species were classified as either adventive (introduced from outside regions) or autochthonous (native). Additionally, the study analyzed the high degree of synanthropization observed in the urban environment, assessing plant adaptation mechanisms to new urban conditions and evaluating the biodiversity of the area. The results included the calculation of species diversity indices, which were recognized as key indicators of the city's ecological status

In a comprehensive study conducted by T.Makhkamov (2024), the taxonomic composition of adventive plant species in Uzbekistan was thorough-

ly examined, and their level of invasiveness was scientifically substantiated. The research provided an in-depth analysis of the successful dispersal mechanisms and ecological factors of particularly aggressive invasive plant species. The impact of these species on biodiversity was assessed, and effective scientific and practical recommendations were developed for combating ecologically harmful invasive species. Additionally, based on the research findings, a dedicated interactive web page was created to provide detailed information on invasive species. O.Sheraliyev's ongoing studies (2024) focus on evaluating the condition of vegetation cover in the Chilustun, Toshota, and Qoraultog' regions. During fieldwork conducted in 2023–2024, approximately 25,000 herbarium specimens were collected, and the ecological status of rare plant species found in these areas was extensively investigated.

In research carried out by O.Turginov (2024), special attention was given to identifying endemic plant species in the mountainous and foothill areas of Andijan Province. The study offered a detailed scientific assessment of the distribution ranges, ecological characteristics, and current status of endemic species growing in these regions, resulting in a compiled list of identified endemic taxa. Furthermore, the growth conditions of these species, ecological changes caused by anthropogenic impacts, and their effects on natural habitats were thoroughly analyzed. The findings provide a solid scientific basis for revealing the unique floristic characteristics of the region and for developing conservation strategies.

METHODOLOGY

1. Study Area, Fieldwork Period, and Research Approach.

During 2022–2025, targeted field research was carried out every year from the second week of February to October to survey the study region (data collecting continued until May 2025). Following the established frameworks of well-known botanists such as A.I.Tolmachev, B.A.Yursev, A.V.Shcherbakov, and S.R.Mayorov, the study used an integrated methodological approach that balanced traditional and modern floristic study approaches.

2. Herbarium Specimen Collection and Taxonomic Identification.

Andijan State University's Department of Ecology and Botany's Herbarium Center now houses more than 6,780 herbarium specimens, representing 405 plant species. To identify these species taxonomically, a mix of traditional and digital resources were utilized. Accurate classification was achieved by consulting extensive multi-volume botanical references, including Flora of Uzbekistan, Flora of Kyrgyzstan, Flora of Tajikistan, and Opredelitel' rasteniy Sredney Azii. The Global Biodiversity Information Facility (GBIF – www.gbif.org) and Plantarium (https://www.plantarium.ru/) are two digital databases that were used to assist and validate species identification (figure 1).



Figure 1. Comprehensive Botanical Research overview.

3. Geospatial Data Collection and Conservation Status Assessment.

By using Google Earth and the MAPS.ME mobile application to record each specimen's geographic coordinates, geospatial data was gathered. Since every plant species was methodically photographed, an extensive photographic archive was produced for reference and validation. The documented species'

conservation status was evaluated using a multifaceted methodology. Primary data on the distribution and abundance of species were obtained by field research carried out between 2022 and 2025. Regional Red Data Books and pertinent literature on biodiversity conservation were also examined. In particular, Categories B1 and B2 (area of occupancy and extent of occurrence) and C2 (population size and decrease) of the International Union for Conservation of Nature (IUCN) were included in the evaluation [14, 15].

4. Geospatial Analysis and Taxonomic Verification.

By combining the GPS coordinates of the evaluated plant species into a CSV file, geospatial analysis was completed. The methods described by Bachman was followed in the creation of distribution maps using these data and GeoCAT (Geospatial Conservation Assessment Tool). Scientific guidance for taxonomic verification was given by O.T.Turginov. The Herbarium Center at Andijan State University performed the final taxonomic identifications, guaranteeing the precision and dependability of the species categorization (figure 2).



Figure 2. Tulipa ferganica is an endemic species native to the Fergana Valley.

Due to anthropogenic pressure (land development, grazing impact, and construction activities), its natural populations are gradually declining. In regional floristic studies, it is classified among rare species that require protection.

RESULTS AND DISCUSSION

Endemic plants are species whose distribution is limited to relatively narrow geographic areas and that occur only in specific regions. The term “endemism” is derived from the Greek word endēmos, meaning “native,” and such species represent a unique and rare component of the flora or fauna.

The formation of endemism is influenced by various factors, including geographical isolation, climate, edaphic (soil) conditions, as well as biological factors such as parasitism and competition. Endemic species are classified into two categories based on the time of their origin: paleoendemics and neoendemics.

Paleoenydemics are ancient, relict species that were once widespread but are now confined to limited areas (e.g., *Ginkgo, Metasequoia,* and *Latimeria*).

Neoendemics**,** on the other hand, are relatively recent species that have emerged through evolutionary processes and are restricted to narrow geographic ranges (e.g., certain faunal species found in Crimea or the British Isles).

There is a clear distinction between endemic species and native species: while native species may also be found in adjacent regions, endemic species are strictly confined to their specific habitats. Their distribution is limited by geographic and ecological isolation, such as islands or high mountain ranges. Uzbekistan is one of the key regions of Central Asia in terms of floral richness. The country hosts a significant number of endemic species, predominantly distributed in mountainous areas. For instance, the Asteraceae (daisy) family in Uzbekistan comprises

122 genera and 567 species, approximately 14.8% of which are endemic. In the Alliaceae (onion) family, 2 out of 6 species (33.6%) are endemic, while in the Plumbaginaceae (leadwort) family, 12 out of 38 species (31.4%) are endemic.

Genera with high levels of endemism include *Kozenia* (52 out of 133 species endemic), *Eremostachys* (13 out of 36), *Acantholimon* (10 out of 24), and *Childzerum* (11 out of 19). Across the entire Central Asian region, the number of endemic plant species reaches 3,336, which accounts for approximately 46% of the total flora. In Uzbekistan, endemic species are mostly concentrated in mountainous areas (337 species), whereas only 44 species are found in lowland regions. These plants are often highly specialized and are typically found in gypsum-rich, saline, variegated rocky or sandy terrains dating back to the Mesozoic and Cenozoic eras, as well as in dry, stony hillsides [2. P. 1110; 3. P. 50].

Today, it has been documented that the global extinction rate of various organisms is at least 1,000 times higher than the natural background rate. This poses a serious threat to biodiversity, which is essential for sustaining life on Earth. Species under threat often exist in fragmented habitats or as isolated populations, conditions that accelerate their extinction in the wild (EW — Extinct in the Wild) or complete extinction (EX — Extinct).

In such circumstances, the lack of sufficient data on species (DD — Data Deficient) or their complete lack of evaluation (NE — Not Evaluated) makes it difficult to determine their risk status. This data deficiency hinders timely conservation efforts and brings these species closer to extinction.

Although international and national measures have been undertaken in recent years to conserve biodiversity, the global biodiversity crisis continues. To mitigate this crisis, identify threatened species, and ensure their effective conservation, the International Union for Conservation of Nature (IUCN) has developed a formal global monitoring system.

As of today, the IUCN database includes more than 138,300 species (approximately 6% of global flora), of which 56,245 are plant species. These plants are assessed based on various criteria and categorized into groups such as CR (Critically Endangered), EN (Endangered), VU (Vulnerable), LC (Least Concern), DD (Data Deficient), and NA (Not Applicable).

In recent years, significant steps have also been taken in the Republic of Uzbekistan to conserve biodiversity. Notably, the 2019 edition of the *Red Data Book of the Republic of Uzbekistan* listed 314 plant species. Of these, 17 species (5.4%) were assessed according to the aforementioned IUCN threat categories.

In 2021, Uzbekistan became the first Central Asian country to attain full membership in the International Union for Conservation of Nature (IUCN). This membership facilitates the global assessment of flora and fauna species in need of protection in Uzbekistan, strengthens international scientific collaboration, and supports initiatives aimed at ensuring ecological security.

The IUCN employs a clearly defined and systematic assessment methodology for evaluating rare and threatened taxa in its Red List. This system considers the following key criteria:

• Extent of Occurrence (EOO) the species' geographic distribution range;

• Population decline over time;

• Total population size;

• Probability of extinction.

However, for many endemic and rare plant species, the official IUCN categories and assessment criteria have yet to be applied. This is primarily due to the lack of up-to-date, accurate, and regularly updated information on these species, as well as the insufficient implementation of targeted research aimed at studying them.

Therefore, in order to assess endemic and rare plant species found in Uzbekistan according to IUCN criteria, it is first necessary to collect scientifically grounded data on their distribution range, ecological status, population size, and the degree of anthropogenic pressure. Such data will enable the inclusion of these species in internationally recognized conservation strategies.

In the next stage of the study, the threat levels of endemic and rare plant species identified in Andijan Province were analyzed based on internationally recognized criteria. For this purpose, the GeoCAT (Geospatial Conservation Assessment Tool) — an interactive tool designed to map and evaluate species distributions using geospatial data based on the IUCN Red List assessment system — was utilized.

The GeoCAT software operates using two key indicators for species assessment:

• Extent of Occurrence (EOO) the overall geographic distribution range of the species,

• Area of Occupancy (AOO) the actual area occupied by the species.

Based on these parameters, species are preliminarily assigned to IUCN threat categories under Criterion B. This approach made it possible to scientifically classify the recorded species into either threatened categories (CR – Critically Endangered, EN – Endangered, VU – Vulnerable) or stable cate-

gories (LC – Least Concern, NT – Near Threatened) within the framework of the study.

The following section presents the EOO and AOO indicators determined through GeoCAT for each plant species, their assessment in accordance with IUCN criteria, and an analysis of the ecological and anthropogenic state of their distribution areas.

Tulipa turkestanica Regel – A perennial, bulbous plant species belonging to the family Liliaceae, *Tulipa turkestanica* is one of the endemic and relict representatives of Central Asia. This species is considered a relict of the Paleogene–Neogene (Tertiary) period based on its evolutionary origin. The genesis of the species is characteristic of the Central Asian and Turkestan floristic regions, and its distribution spans across Uzbekistan, Kazakhstan, Kyrgyzstan, Tajikistan, and parts of China[20. P. 119].

This species is morphologically distinguished from other *Tulipa* representatives by the unique shape, color, and structure of its flowers. The flowers are white or pale yellow, with yellow spots adorning the inner parts. The leaves are narrow, linear, and grayish-green in color, usually emerging in large numbers from the bulb. *Tulipa turkestanica* is primarily found in low to mid-mountain regions, at elevations ranging from 800 to 1600 meters above sea level. It typically grows in petrophytic and ephemeral plant communities in foothill and mountainous zones, as well as on mountain slopes and dry meadows. This species is widespread in areas with poorly developed soil layers, particularly on stony and gravelly terrains.

Due to its botanical, ecological, and aesthetic significance, *Tulipa turkestanica* stands out as a notable species. Based on coordinates identified through recent research, the precise distribution range of this species was mapped using the GeoCAT (Geospatial Conservation Assessment Tool) software, and its threat level was assessed according to IUCN Red List criteria (Figure 2).



Figure 3. Field Photography of *Tulipa turkestanica.*

GeoCAT Assessment Based on the Distribution Map.

Extent of Occurrence (EOO):

Value: 41,255.369 km².

EOO represents the overall geographic range of the species. This value is relatively large and corresponds to the *"Near Threatened" (NT)* or *"Least Concern" (LC)* category under IUCN criteria. The species has been recorded in the mountainous regions of Uzbekistan, Kyrgyzstan, and Tajikistan. hyyyy

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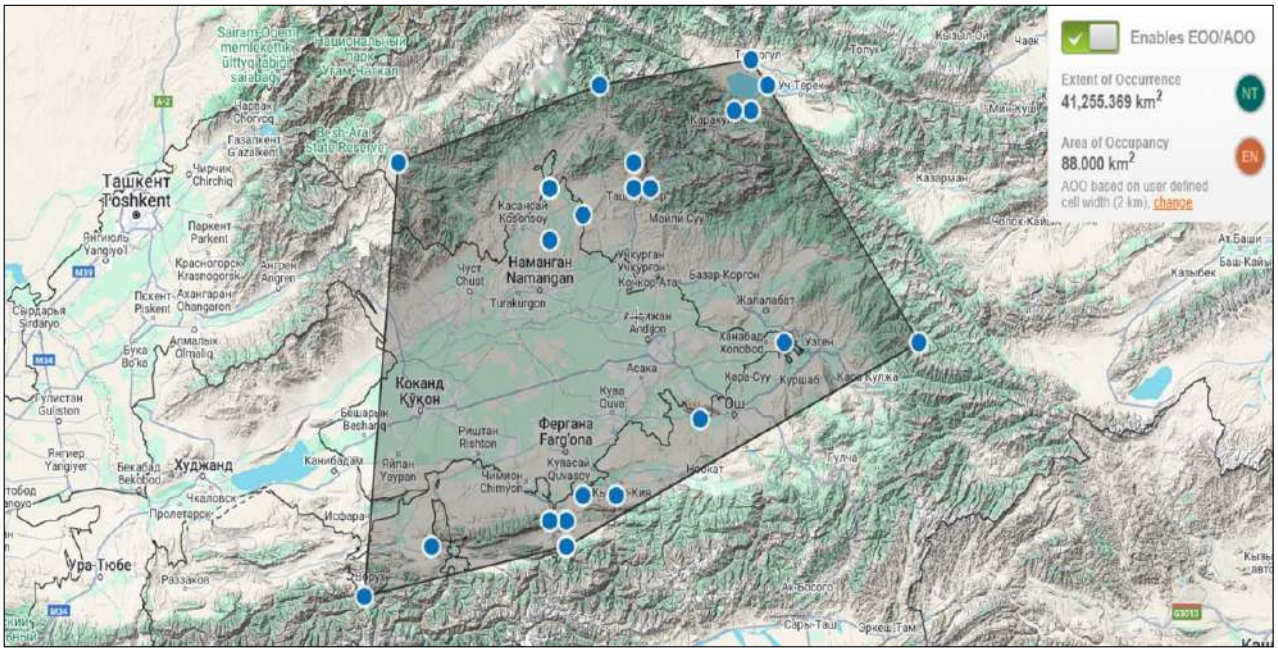


Figure 4. GeoCAT Distribution Map of *Tulipa turkestanica*.

Population dynamics: Although the species population remains stable in some locations, declines have been observed at many recorded sites, which negatively impacts overall biodiversity.

Area of Occupancy (AOO):

Value: 88 km² (based on 2×2 km grid cells)

The AOO value is quite low and, according to IUCN criteria, provides sufficient grounds to categorize the species as *Endangered (EN)* (threshold: less than 500 km²).

Natural Condition and Threat Factors:

• **Restricted range and fragmentation:** The distribution area is narrow, and populations are geographically isolated and becoming increasingly fragmented.

• **Anthropogenic threats:** These include livestock grazing, land development, road and construction activities, and widespread collection of the plants for ornamental purposes.

IUCN Assessment Summary.

Based on Criterion B2 of the IUCN Red List (AOO < 500 km², observed fragmentation, and continuing decline), Tulipa turkestanica can be evaluated as follows:

• **IUCN Category:** EN – Endangered

• **Criterion:** B2ab(iii)

• **Justification:** The species has an Area of Occupancy (AOO) of 88 km², which is well below the 500 km² threshold. Its populations are fragmented, and its habitat is undergoing continuous decline.

Tulipa turkestanica is considered one of the rare representatives of the flora of Uzbekistan and the wider Central Asian region (figure 4) . It is characterized by:

• low ecological adaptability,

• a restricted distribution range,

• and declining populations under anthropogenic pressure.

Therefore, it is essential to continue scientifically based efforts for the official inclusion of this species in the IUCN Red List, along with long-term monitoring, ***in situ*** and ***ex situ*** conservation measures. Recommendations for its conservation include propagation in botanical gardens, preservation in gene banks, and raising awareness among local communities.



Figure 5. Field Photography of *Fritillaria rugillosa.*

Fritillaria rugillosa Naumenko & Zubov is a newly described plant species in the family Liliaceae, classified in 2021 by Alexander Naumenko and Dmitriy Zubov. This species was discovered in the southeastern part of the Fergana Valley, particularly in the mountainous regions of Jalal-Abad Province, Kyrgyzstan [22. P. 547].

Previously, it was often confused with *Fritillaria stenanthera*, but recent morphological analyses have confirmed its status as a distinct species. The flowers are broadly open and almost flat, wheel-shaped, with tepals that extend outward horizontally, a feature that distinguishes it from *F. stenanthera*, whose flowers are campanulate (bell-shaped) and constricted at the base.

Its filaments are purple or violet in the lower two-thirds, with the lower part being hairy and the upper part white and glabrous (hairless).

Morphologically, the flowers of *Fritillaria rugillosa* are widely open, almost flat, and wheel-shaped, with tepals directed outward to the sides, a feature that distinguishes it from its close relative, *Fritillaria stenanthera*. In contrast, *F. stenanthera* has bell-shaped flowers that gradually narrow toward the base.

In addition, the filaments of *F. rugillosa* are purple in the lower two-thirds, with the lower portion being hairy and the upper portion white and glabrous. This combination of traits further differentiates it from other related species.

Geographically, *Fritillaria rugillosa* is widely distributed in the southeastern part of the Fergana Valley, particularly in the mountainous regions of Jalal-Abad and Osh Provinces of Kyrgyzstan. Within Uzbekistan, it has been recorded in the Tashkent, Namangan, and Andijan regions, especially in the Chatkal, Kurama, and Alay mountain ranges [23;75].

During the study, the distribution of *Fritillaria rugillosa* Naumenko & Zubov was analyzed using the GeoCAT software. As a result of the mapping, the species' Extent of Occurrence (EOO) and Area of Occupancy (AOO) were determined as follows:

• **Extent of Occurrence (EOO):** 19,080.908 km²

• **Area of Occupancy (AOO):** 68.000 km² (based on 17 distribution points within 2×2 km grid cells)

The distance between distribution points was found to be relatively large, ranging from 10 to 70 km, indicating that the populations are fragmented — that is, distributed in a disjointed pattern (Figure 5).

Since the EOO indicator is slightly below 20,000 km², the species qualifies for the *"Vulnerable (VU)"* category under IUCN criteria. However, the AOO indicator is below 100 km², qualifying the species for the *"Endangered (EN)"* category.

Based on these indicators, *Fritillaria rugillosa* can be assessed as a species falling under the following IUCN criteria:

IUCN Threat Category: EN – Endangered

Criteria: B1ab(ii,iii) + B2ab(ii,iii,iv)

Justification: The species has a restricted and fragmented range; ongoing habitat loss, ecological degradation, and population fragmentation have been observed.

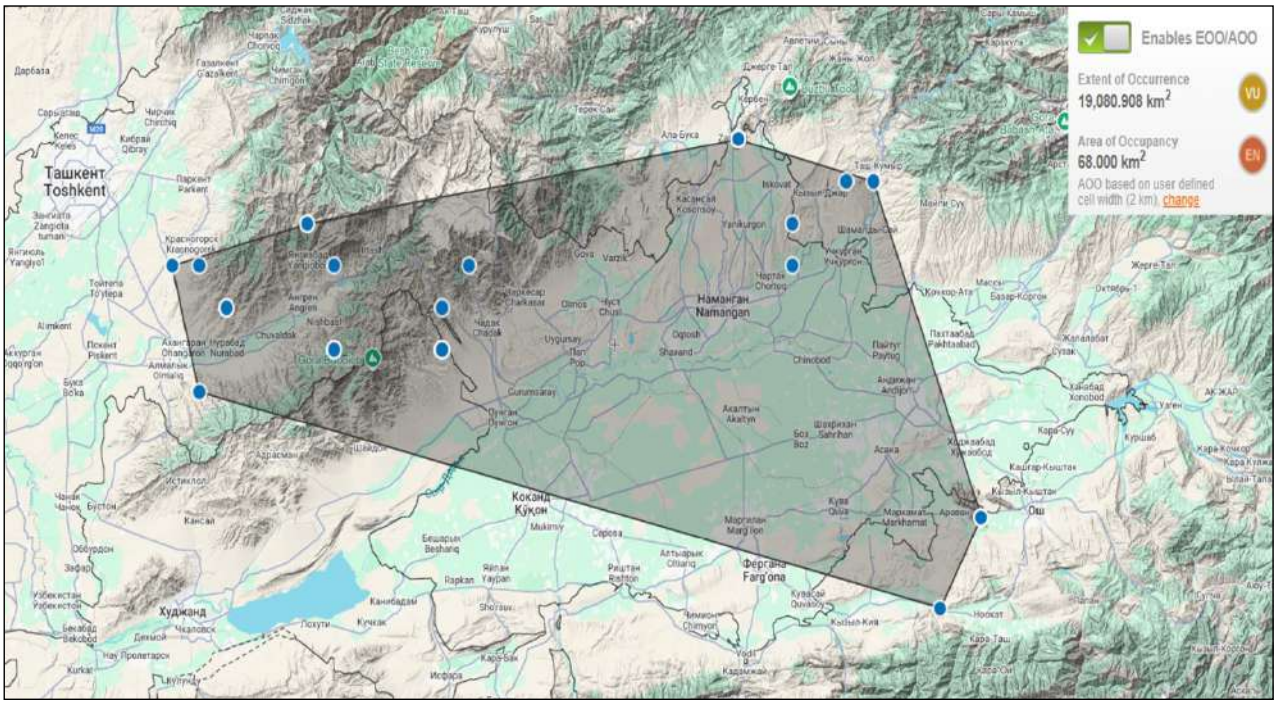


Figure 6. GeoCAT Distribution Map of *Fritillaria rugillosa*.

This analysis, within the framework of the study, scientifically confirms the conservation need for *Fritillaria rugillosa* and highlights the necessity of including it in the "Endangered" category of the IUCN Red List.

Assessment of *Geranium baschkyzylsaicum* Nabiev. according to IUCN criteria (based on GeoCAT analysis)

Geranium baschkyzylsaicum Nabiev. is a rare species with a relatively narrow range, found in the Fergana Valley and adjacent mountainous regions. To determine the geographic distribution and assess its threat level, the GeoCAT tool was utilized (Figure 6).

According to the GeoCAT mapping results, the following indicators were identified:

- **Extent of Occurrence (EOO):** 19,264.651 km²
- **Area of Occupancy (AOO):** 16.000 km²

(Only 4 local occurrence points were recorded based on 2×2 km grid cells.)

The AOO value being significantly below 100 km², along with the EOO value being close to the 20,000 km² threshold, indicates that this species is under threat. The distances between the distribution points are wide and fragmented, and in some cases, they are located entirely in isolated ecotones, reflecting a high degree of habitat fragmentation and degradation of the species' natural environment.

Also, the natural habitats of this species are affected by anthropogenic pressure, such as agricultural activities, livestock grazing, and land development. These factors pose a threat to its ecological stability [26. P. 3605].

Based on the above criteria and conditions, *Geranium baschkyzylsaicum* Nabiev. can be assessed by IUCN according to the following criteria:

IUCN threat category: EN – Endangered.

Criteria: B1ab(ii,iii)+2ab(ii,iii,iv)



Figure 6. GeoCAT Distribution Map of *Geranium baschkyzylsaicum*.

Justification: Narrow distribution range (AOO = 16 km²), fragmentation, reduction of habitats, deterioration of ecological conditions, and large distances between population points.

This analysis provides the scientific basis necessary to assess *Geranium baschkyzylsaicum* as "Endangered" in the IUCN Red List. For this species, it is recommended to establish a specific monitoring system, preserve its distribution area, and implement measures to reduce anthropogenic pressure [24. P. 226].

Iris narynensis O.Fedtsch. belongs to the family Iridaceae and typically grows at elevations of 800–2000 meters above sea level, in dry, rocky, and sandy soils. This species is adapted to specific ecological conditions and occurs in narrowly specialized ecotopes. Therefore, its distribution range is relatively limited, and it is evaluated as a conditionally endemic species. The species can survive only in natural conditions, and cases of artificial planting or transplantation are limited and rarely observed (figure 6).



Figure 7. Field Photography of Iris narynensis.

This species is a perennial plant with stems that spread along the ground, usually reaching heights of 30–40 cm. Its leaves are narrow, elongated, linear, and succulent in structure. The flowers are large, ranging from pale to deep orange, displaying an ornamental appearance typical of the genus Iris. The outer perianth segments are broader, while the inner segments are narrow and upright, contributing to the aesthetic attractiveness of the flowers.

Iris narynensis differs from other representatives of the genus *Iris* (e.g., *Iris korolkowii* or *Iris persica*) by its morphological and ecological features. Particularly, it attracts the attention of botanists due to its adaptation to high mountain habitats, drought tolerance, and distinctive floral structure.

Iris narynensis O. Fedtsch. is a rare and ecologically sensitive plant species characteristic of the eastern mountainous regions of Uzbekistan, particularly the Fergana Valley and adjacent mountain ranges. To determine its distribution status and assess its threat level, an analysis was conducted using the GeoCAT (Geospatial Conservation Assessment Tool) platform.

According to the results obtained from GeoCAT, the species has the following indicators:

- **Extent of Occurrence (EOO):** 8,060.254 km².
- **Area of Occupancy (AOO):** 48.000 km².

(based on 12 local points with a cell size of 2×2 km).

Given that the EOO value is less than 20,000 km² and the AOO is significantly below 100 km², this species can be classified as endangered according to the IUCN criteria B1 and B2. Distribution points of this species are mostly confined to foothills and upper zones and are isolated (fragmented) from each other. Its habitat—mountainous and rocky areas—is currently losing stability due to factors such as livestock grazing, pasture expansion, illegal plant collection, and climate change (Figure 7).

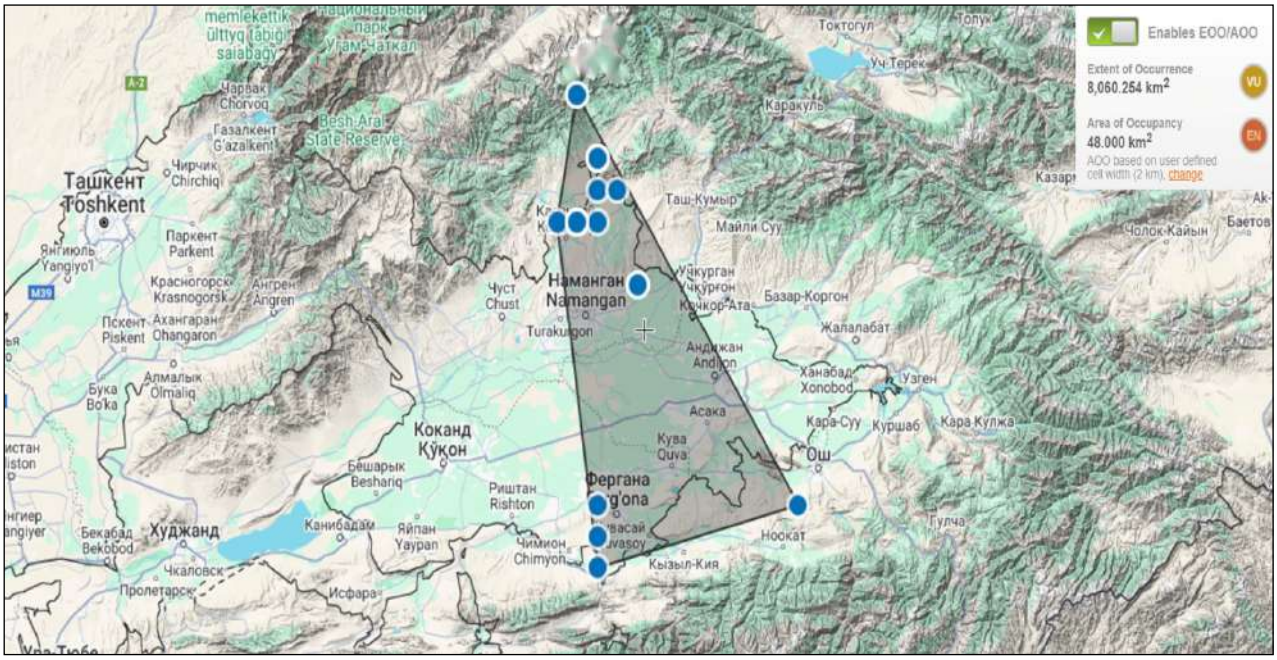


Figure 8. GeoCAT Distribution Map of *Iris narynensis.*

In addition, the population of *Iris narynensis* is exhibiting a sharp declining trend under natural conditions, necessitating extensive monitoring and conservation of its habitats.

Considering the factors described above, *Iris narynensis* can be assessed as follows:

IUCN threat category: EN – Endangered.

Criteria: B1ab(ii,iii)+2ab(ii,iii,iv).

Justification: Narrow and fragmented distribution (values of EOO and AOO), habitat degradation, anthropogenic pressures, population fragmentation, and potential for further decline.

This assessment scientifically demonstrates that *Iris narynensis* is endangered and highlights the necessity of including it in the IUCN Red List. Such data may play a significant role in developing conservation plans (figure 8).

The ecological assessment of endemic plant species in the mountainous and foothill regions of Andijan Province reveals broader trends relevant to biodiversity conservation in Central Asia. While the inventory of species and threat assessments constitute foundational work, the present study goes further by illustrating how anthropogenic transformation

particularly land fragmentation, overgrazing, and unregulated development is actively reshaping the ecological integrity of sensitive habitats. A critical observation is the spatial incongruity between the extent of occurrence (EOO) and the area of occupancy (AOO) across several species. This reflects the increasing isolation of viable populations, which in turn amplifies genetic bottleneck risks and reduces species resilience. For example, despite relatively wide potential ranges, species such as *Tulipa turkestanica* and *Fritillaria rugillosa* remain confined to narrowly suitable microhabitats, highlighting the influence of edaphic and climatic niche specialization.

The integration of classical floristic taxonomy with geospatial tools like GeoCAT enhances the reliability of threat evaluations, particularly under IUCN's Criterion B. Such methodological synergy offers a replicable model for other floristically rich but underexplored regions in Central Asia. The current findings underscore that relying solely on species counts is insufficient spatial configuration and population dynamics must also be systematically considered in conservation planning. Another noteworthy implication concerns policy and management. While Uzbekistan has made formal commitments to biodiversity protection, the field data suggest that enforcement gaps and insufficient local engagement remain challenges. Conservation must thus evolve beyond documentation into action-oriented strategies including habitat zoning, legal protection of microrefugia, and participatory monitoring involving local communities. Moreover, this study highlights the conservation potential of endemic taxa as bioindicators. Because these species are hypersensitive to environmental changes, shifts in their population structure and distribution can serve as early-warning signals for ecosystem degradation. This function is particularly vital in semi-arid mountainous systems, where ecological thresholds can be crossed rapidly.

CONCLUSION

The mountainous and foothill areas of Andijan Province are distinguished by their unique floristic diversity. In this study, the ecological, floristic, and geographical characteristics of endemic and rare plant species distributed in these areas were thoroughly investigated. Research has shown that biodiversity loss is a global ecological problem, posing a serious threat especially to endemic species with narrow distribution ranges. The study found that most plant species assessed according to IUCN criteria fall into the Endangered (EN) category. Identified species such as Tulipa turkestanica, Fritillaria rugillosa, Geranium baschkyzylsaicum, and Iris narynensis have restricted ranges, and their habitats are under significant anthropogenic pressure. Mapping the current status of these species and assessing their threat level using the GeoCAT tool allowed for scientifically grounded recommendations regarding their inclusion in the IUCN Red List. Furthermore, increasing fragmentation of rare species populations, and intensifying degradation of their distribution areas and habitats, necessitate their *in-situ* and *ex-situ* conservation. The findings of this study create an important scientific-practical platform based on the Red Book of the Republic of Uzbekistan, the National Biodiversity Conservation Strategy (2019–2028), and international IUCN standards. Therefore, systematic monitoring of endemic plant species in the region, evaluation of their population dynamics, increasing ecological awareness among local communities, and the structured implementation of conservation measures should be considered an urgent ecological task. These results contribute not only to regional ecological security but also directly support international efforts to conserve global biodiversity.

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FARG‘ONA VODIYSINING ANDIJON VILOYATIDA TARQALGAN ENDEMIK TURLAR VA ULARNI MUHOFAZA QILISH

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Kalit so‘zlar: *Andijon viloyati, IUCN mezonlari, endemik turlar, noyob turlar, populyatsiya, GeoCAT, xavf darajasi.*

Andijon viloyatining tog‘li va tog‘ oldi zonalari O‘zbekistonning eng muhim floristik hududlaridan biri bo‘lib, noyob, endemik va ekologik jihatdan sezgir o‘simlik turlarining boylik markazi sifatida xizmat qiladi. Ushbu maqolada 2022–2025-yillar davomida o‘tkazilgan keng ko‘lamli dala tadqiqotlari natijalari keltirilgan. Tadqiqot davomida hududda o‘suvchi 405 ta o‘simlik turi tizimli ravishda aniqlanib, ularning ekologik holati, geografik tarqalishi, populyatsiya dinamikasi va tahdid darajalari har tomonlama tahlil qilindi.

Xalqaro Tabiatni muhofaza qilish ittifoqi (IUCN) va Geospatial Conservation Assessment Tool (GeoCAT) mezonlari asosida muhim muhofaza ko‘rsatkichlari — Extent of Occurrence (EOO) va Area of Occupancy (AOO) hisoblab chiqildi. Tahlillar natijasida *Tulipa turkestanica*, *Fritillaria rugillosa*, *Geranium baschkyzylsaicum* va *Iris narynensis* kabi turlar tarqalish arealining torligi, populyatsiyalarining parchalangani hamda davom etayotgan antropogen bosimlar tufayli “Xavf ostidagi turlar” (EN — Endangered) sifatida tasniflanishi kerakligi aniqlandi.

Bunday bosimlarga yo‘l qurilishi, chorva mollarining haddan tashqari boqilishi, tabiiy resurslardan noo‘rin foydalanish hamda manzarali yoki dorivor maqsadlarda o‘simliklarni noqonuniy terib olish kiradi. Tadqiqotda klassik floristik usullar zamonaviy geoinformatsion texnologiyalar bilan uyg‘unlashtirilib, ilmiy asoslangan muhofaza yondashuvi ta’minlandi. Shuningdek, in-situ (joyida) va ex-situ (joyidan tashqarida) muhofaza strategiyalarini ishlab chiqish, gen banklarini tashkil etish va mahalliy aholining ekologik ongini oshirishga qaratilgan amaliy tavsiyalar ishlab chiqildi.

Ushbu natijalar O‘zbekiston Respublikasining “Qizil kitobi” (2019), “Biologik xilma-xillikni saqlash milliy strategiyasi” (2019–2028) hamda IUCN xalqaro standartlarida belgilangan maqsad va ustuvor yo‘nalishlarga mos keladi. Shu tariqa, mazkur tadqiqot nafaqat mintaqaviy ekologik xavfsizlikni ta’minlashga, balki global biologik xilma-xillik inqirozini bartaraf etish bo‘yicha ilmiy-amaliy asoslar yaratishga xizmat qiladi.

Endemik turlar bilan mahalliy (native) turlar o‘rtasida aniq farq mavjud: mahalliy turlar qo‘shni hududlarda ham uchrashi mumkin bo‘lsa, endemik turlar faqat o‘ziga xos yashash joylariga xosdir. Ularning tarqalishi geografik yoki ekologik ajralganlik, masalan, orollar yoki baland tog‘ tizmalari kabi omillar bilan cheklanadi.

O‘zbekiston Markaziy Osiyoning floristik boyligi jihatidan eng muhim hududlaridan biri hisoblanadi. Mamlakatda endemik o‘simlik turlari soni sezilarli bo‘lib, ular asosan tog‘li hududlarda tarqalgan. Masalan, O‘zbekistonda Asteraceae (qoqio‘tlilar yoki astr) oilasiga mansub 122 ta turkum va 567 ta tur mavjud bo‘lib, ularning taxminan 14,8 foizi endemik hisoblanadi. Alliaceae (piyozdoshlar) oilasida mavjud 6 ta turdan 2 tasi (33,6%) endemikdir. Shuningdek, Plumbaginaceae (qo‘rg‘oshindoshlar) oilasiga kiruvchi 38 ta turdan 12 tasi (31,4%) endemik tur sifatida qayd etilgan.

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