

Analysis of Endemic Plant Species Listed in the Red Book of Southwestern Gissar (Case Study: Katta and Kichik Uradarya Basins and Gissar State Nature Reserve)

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Abstract

This article presents an analysis of certain rare and endemic plant species listed in the Red Data Book of the Republic of Uzbekistan, occurring in the southwestern Hissar region, specifically within the basins of the Katta and Kichik Uradarya rivers and the Hissar State Nature Reserve. The study identifies four endemic species belonging to four distinct families and genera. All recorded taxa are classified as hemicryptophytes in terms of their life form. The research highlights their ecological and chorological characteristics, distribution ranges, and current conservation status. Based on the findings, scientifically grounded recommendations are proposed for the in-situ conservation of these species.

Keywords

Bioreserve, Katta Uradarya, Kichik Uradarya, Gissar State Nature Reserve, Flora, Red Data Book, Endemic Species, Taxonomy, Conservation

1. Introduction

Endemic species are of high conservation priority due to their restricted geographic distribution and vulnerability to environmental changes. These species are often confined to specific, limited habitats, and even minor ecological disturbances—whether natural or anthropogenic—can lead to their rapid decline or extinction

[1]. The study of Uzbekistan's flora has a long history, beginning with the foundational work of Lipsky in 1897 and continuing through to the most recent investigations by O. T. Turginov, which provide valuable insight into regional plant diversity [2], according to K.Sh. Tojibaev *et al.*, a total of 63 endemic species belonging to 20 families and 35 genera have been documented in the Surkhandarya region [3].

In recent years, floristic studies across Uzbekistan have adopted modern methodologies, notably the implementation of a 5 × 5 km grid-based GIS mapping system. This comprehensive approach divides the territory into 19,240 indexed units for detailed biogeographic analysis [4].

The study area—including the Katta and Kichik Uradarya river basins and the Gissar State Nature Reserve—is situated within the Kashkadarya floristic region of the Southwestern Gissar biogeographic province of Uzbekistan [4]. These basins primarily fall within Dehqonobod district and border parts of Yakkabag, Qamashi, and Guzar districts. Elevations range from 654 m to 2875 m above sea level. The lowest point (index AD186) is located in Bozortepa village, while the highest point (index AH193) lies near Qiziltom village and the Maydanak Observatory. The total mapped area of these basins covers 174,928 hectares and includes 94 indexed grid units [5].

The Gissar State Nature Reserve lies within the same floristic region, extending over parts of the Shahrisabz, Yakkabag, and Kamashi districts of Kashkadarya region. It spans altitudes from 1750 to 4366 m and borders Surkhandarya region to the south and the Republic of Tajikistan to the east. The reserve constitutes a continuous massif stretching 37 km east to west and 90 km north to south. The highest peak—an unnamed summit in the Turtquylyk range—rises to 4421 meters above sea level, marking the highest natural point in Uzbekistan [6]. The reserve's grid-based floristic map includes 58 indexed units and covers approximately 81,000 hectares.

2. Research Methods

The loss of species in natural populations is largely linked to increasing anthropogenic pressures, particularly the expansion of human populations, which leads to habitat degradation, fragmentation, or complete destruction. These pressures contribute to environmental pollution and climate change, ultimately disrupting genetic diversity and increasing the risk of species extinction [7] [8].

Endemic species are considered among the most vulnerable organisms due to their limited distribution and small population sizes. Their conservation is recognized as a globally significant and urgent issue. Therefore, national-level strategies are essential to ensure their protection and long-term survival [9].

Initial floristic studies in the Kashkadarya Basin were conducted by S. M. Mustafayev (1966), who documented 1184 vascular plant species from 73 families and 473 genera, including 74 endemic taxa [10]. Later, O. Eshtemirov (2019) reported 70 endemic species in the same region [11].

In recent decades, research on endemic species has expanded significantly, encompassing taxonomic groups, endemism fractions, and their conservation status ([12]: pp. 70-91). The first comprehensive studies on the endemic flora of Southwestern Hissar were conducted by L. I. Vasilyeva and I. T. Vasilchenko (1970), identifying 203 endemic and 60 subendemic species from 29 families and 100 genera [13]. F. O. Khasanov (2018) further documented 124 endemic species from 22 families and 55 genera in this region [14]. More recent assessments have recorded 121 endemic taxa in the Southwestern Hissar province [15].

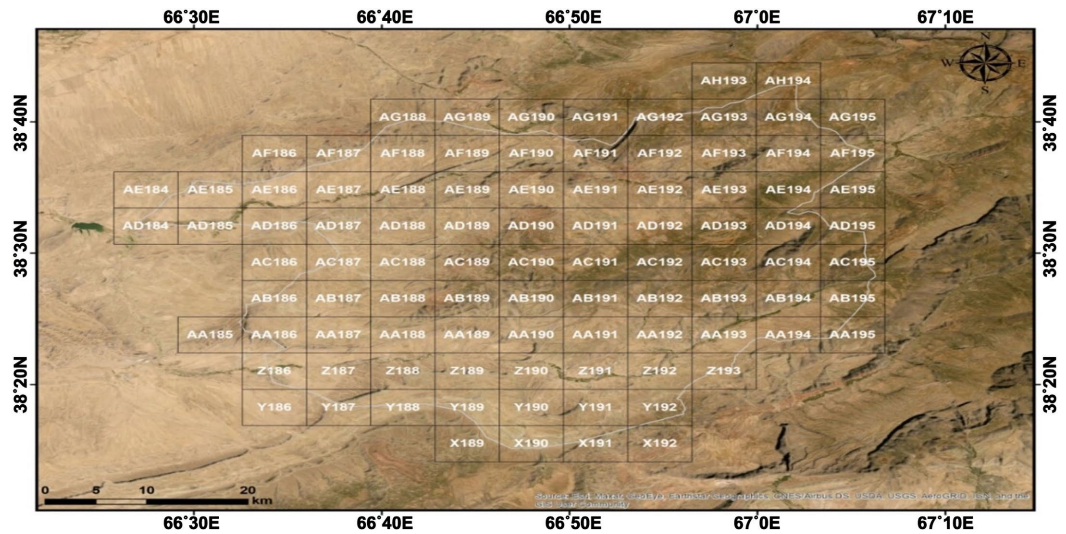


Figure 1. Grid-based (5 × 5 km) distribution map of the flora within the Katta and Kichik Uradarya river basins.

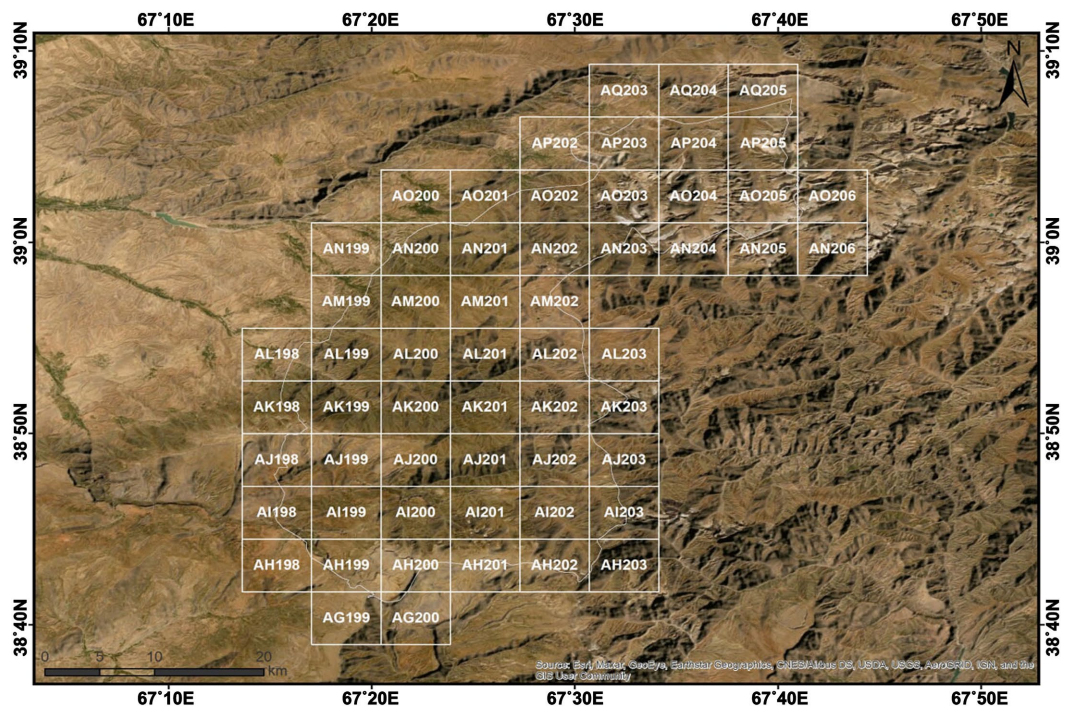


Figure 2. Grid-based (5 × 5 km) map of the Gissar State Nature Reserve.

A literature review indicates that, although various studies have been conducted in and around these areas, targeted research using geolocation and GIS-based methodologies has been insufficient (Figures 1-3).

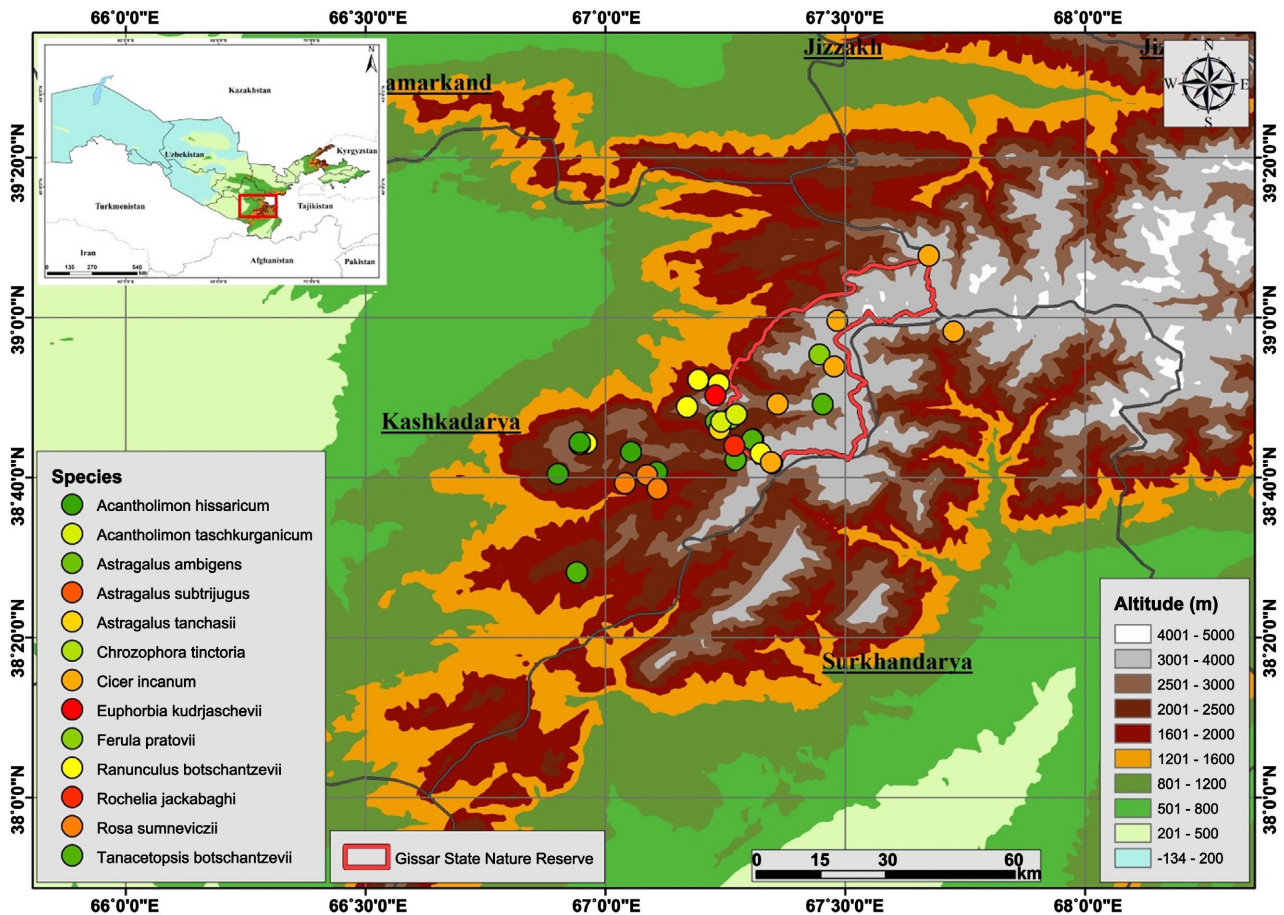


Figure 3. Grid-based (5 × 5 km) distribution map of selected endemic plant species listed in the Red Data Book, occurring in the Southwestern Gissar region. (Source: ArcGIS 10.6)

This study was carried out based on the botanical-geographical zoning scheme of Uzbekistan [4]. Geolocation data were collected using Google Earth Pro (2019) and MAPS.ME applications. Field surveys followed the geobotanical methodologies developed by A. I. Tolmachev [16], A. V. Sherbakov, and C. R. Mayorov [17].

Floristic distribution maps were created using ArcGIS version 10.6.1, with projection based on the WGS 1984 (World Geodetic System 1984). The study focused on the urban flora of Karshi city (Kashkadarya region) and selected endemic species from the Katta and Kichik Uradarya basins. Taxonomic identifications and nomenclature of species were verified using global plant databases such as POWO (Plants of the World Online, 2023) and IPNI (International Plant Names Index, 2023) [18] [19].

The conservation status and distribution of rare and endemic species in this study were determined based on the official data provided in the *Red Data Book of the Republic of Uzbekistan* (2019 edition) [20].

Primary research materials included published dissertations, scientific articles, monographs, herbarium collections from the target region and its adjacent areas, and classical floristic sources such as the 11-volume *Opredelitel rasteniy Sredney Azii* (1963-2015) [21], the 6-volume *Flora Uzbekistana* (1941-1962) [22], and the 30-volume *Flora of the USSR* (1934-1964) [23]. Additional data were obtained from herbarium specimens preserved in the National Herbarium of Uzbekistan (TASH) and specimens collected during fieldwork.

Historical and contemporary investigations reveal that floristic research in the study area began with the works of Lipsky in 1897 and has most recently been expanded by O. Turginov in 2022 [2]. Notable contributors to herbarium collections from this region include: **A. Pyatayeva** (1942-1980): 201 species, 495 specimens; **E. Korotkova** (1935-1972): 85 species, 143 specimens; **A. Arnold** (1942): 85 species, 114 specimens; **S. N. Kudryashev** (1935-1941): 53 species, 67 specimens; **M. G. Popov** (1914-1916): 49 species, 62 specimens; **A. Gnezdillo** (1935): 42 species, 61 specimens; **A. Li and B. Niyazov** (1950-1959): 39 species, 62 specimens; **N. Koshurnikova** (1941-1956): 37 species, 43 specimens; **O. Turginov** (2011-2022): 28 species, 42 specimens [2].

In his recent doctoral dissertation titled “*Endemics of Uzbekistan*” (2024), O. Turginov compiled a comprehensive list of 326 endemic plant species represented by 2391 herbarium specimens from across the country [24].

Study Area

The study area encompasses the Katta and Kichik Uradarya river basins and the Gissar State Nature Reserve, located in the southwestern part of the Gissar Mountain Range within the Kashkadarya Province of Uzbekistan. According to the botanical-geographical regionalization scheme of Uzbekistan, this territory belongs to the Southwestern Gissar floristic district, which is part of the larger Western Pamir-Alai mountain system.

Geographically, the Katta and Kichik Uradarya basins extend across the Dehqanabad district and partially intersect with the Yakkabog, Kamashi, and Guzar districts. The elevation of the area ranges from 654 m to 2875 m above sea level, covering four distinct altitudinal zones. The lowest point (654 m) is located in the Bozortepa village of Dehqanabad district (index AD186), while the highest point (2875 m) corresponds to the Kiziltom area and the Maydanak Observatory (index AH193) in Kamashi district.

Previous work by the authors [25] revealed, based on TASH herbarium data, that the flora of the study area comprises 606 species from 55 families and 256 genera. According to the 2019 *Red Data Book of Uzbekistan* [26], 59 species (from 19 families and 37 genera) from this region are officially listed. Our earlier analysis of the endemic flora of the same region [27] documented 52 endemic species belonging to 17 families and 30 genera. A chronological review of floristic studies focusing on endemic species in the Katta and Kichik Uradarya basins shows that research has been conducted intermittently from 1913-2025 years, involving var-

ious researchers at different stages, allowing for a temporal analytical framework of species documentation.

In our country, significant scientific research has been conducted on rare plant species [28]-[35], including their distribution and population status [36]-[42].

In recent years, extensive floristic and geobotanical studies have been conducted across Central Asia. These investigations play a critical role in documenting the region's rich and unique plant diversity, contributing to the conservation of biodiversity, ecological monitoring, and the sustainable management of natural resources. Particular attention has been given to the distribution, habitats, and phytogeographical characteristics of endemic and rare plant species [43]-[47].

3. Results

During the analysis of endemic plant species listed in the *Red Data Book of the Republic of Uzbekistan* and found within the study area, the following classification was established. These species are currently classified among those in urgent need of conservation. In recent years, the increasing intensity of various anthropogenic and environmental pressures has had a detrimental impact on their populations and natural habitats (Table 1).

Table 1. Endemic plant species recorded in the study area that are listed in the Red Data Book of Uzbekistan.

№	Family	Genus	Species	Status	Lofo form
1.	Asteraceae	Tanacetopsis	<i>Tanacetopsis botschantzevii</i> (Kovalevsk.) Kovalevsk	2	Hemicryptophyte
2.	Apiaceae	Ferula	<i>Ferula pratovii</i> F. O. Khasanov & I. I. Mal'tsev	1	Hemicryptophyte
3.	Fabaceae	Cicer	<i>Cicer incanum</i> Korotkova	1	Hemicryptophyte
4.	Euphorbiaceae	Euphorbia	<i>Euphorbia kudrjashevii</i> (Pazij) Prokh	0	Hemicryptophyte

As shown in the table, the flora of the studied areas includes four endemic plant species listed in the *Red Data Book of the Republic of Uzbekistan* (2019), belonging to 4 families, 4 genera, and 4 species (Figure 4). All identified taxa exhibit a hemicryptophytic life form, indicating their adaptation to cold climates and unfavorable environmental conditions.

In fact, the categories used in the Red Data Book of Uzbekistan differ from those of the IUCN Red List. Category 0 (Probably Extinct) roughly corresponds to the IUCN categories EX (Extinct) and EW (Extinct in the Wild).

Category 1 (Endangered) is approximately equivalent to the IUCN categories CR (Critically Endangered) and EN (Endangered). Category 2 (Rare) aligns with the IUCN categories EN and VU (Vulnerable). Category 3 (Declining) is compa-

rable to the IUCN categories VU and NT (Near Threatened).

The conservation statuses of these endemic species, according to the classification provided in the *Red Data Book*, are distributed as follows:

Category 0—Probably extinct or possibly extinct in the wild: 1 family, 1 genus, and 1 species fall into this category.

Category 1—Critically endangered: 2 families, 2 genera, and 2 species are classified under this status.

Category 2—Rare species: 1 family, 1 genus, and 1 species are included here.

Category 3—Declining in numbers: No species were recorded under this category.

This analysis demonstrates that the majority of the species fall under Category 1 (Critically Endangered), suggesting an urgent need for conservation. In contrast, the number of species under Category 0 (Possibly Extinct) and Category 2 (Rare) is relatively low, while no species from the study area were found to be classified under Category 3 (Declining in numbers).



Astragalus subtrijugus



Ferula pratovii

Figure 4. Any rare species.

4. Conclusions

This study systematically investigated the taxonomic and ecological status of endemic plant species included in the Red Data Book of the Republic of Uzbekistan, distributed within the flora of the Southwestern Hisor region (the basins of the Greater and Lesser Uradaryos and Hisor State Reserve). The four identified endemic species belong to four families and orders, all exhibiting a hemicryptophyte life form, indicating their high adaptability to cold and arid environmental conditions.

The results demonstrate that these endemic species are predominantly under a high threat level (critically endangered), with limited natural populations and nar-

row distribution ranges negatively impacting their genetic diversity. Moreover, recent ecological changes and anthropogenic factors, including habitat degradation, pose a significant risk of extinction for these taxa.

From the perspective of conservation biology, the findings underscore the urgent need for targeted measures to protect these endemic floras and ensure sustainable management of their genetic resources. Expanding protected areas, conducting systematic monitoring, implementing ecological rehabilitation, and adopting propagation techniques aligned with the species' ecological requirements are strongly recommended to stabilize their populations.

Furthermore, it is essential to deepen scientific research by digitizing existing floristic data and employing GIS technologies to accurately map the geographic distribution of these plants, identify critical habitats, and support ecological stability. Such efforts will play a vital role in preserving Uzbekistan's biodiversity and transmitting this natural heritage to future generations.

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Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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