Arabian Journal of Science

ISSN:2308-5703

Impact factor:13.5 *International Multidisciplinary Online Journal* July, 2026

# COMPARATIVE ANALYSIS OF ENDEMIC PLANT SPECIES INCLUDED IN THE RED DATA BOOK OF THE REPUBLIC OF UZBEKISTAN ACROSS THE ZARAFSHAN REGION AND THE VOHA (SURKHANDARYA–KASHKADARYA) TERRITORY

**Foziljon O. Omanov**

2nd-year student, Yangiyer Branch of Tashkent Institute of Chemical Technology

ORCID: 0009-0004-9255-1076

E-mail: f28115560@gmail.com

**Abstract.** This article presents a comparative analysis of the distribution, family composition, life forms, geographical distribution, conservation categories, and anthropogenic threat factors of endemic plant species included in the Red Data Book of the Republic of Uzbekistan for the Zarafshan region (92 species) and the Voha territory (158 species). A total of 250 endemic species were examined, of which 25 occur in both areas. The Voha territory contains 1.7 times more endemic species than the Zarafshan region, confirming its status as one of the most biologically diverse areas of Uzbekistan. In both regions, the families Fabaceae and Asteraceae predominate, while perennial herbs constitute the dominant life form. The study identified pasture overgrazing and the harvesting of medicinal plants as the most significant threat factors for both regions.

**Keywords:** endemic plants, Red Data Book, Zarafshan region, Voha territory, conservation category, biological diversity, Nurata Range, Hissar Range.

**Introduction** The flora of Uzbekistan is among the most biologically diverse in Central Asia, with more than 4,500 recorded plant species within the republic. Of these, approximately 500 are endemic — that is, restricted in their distribution to Uzbekistan or immediately adjoining territories [1]. A substantial proportion of these endemic species has been included in the Red Data Book of the Republic of Uzbekistan, making their conservation a matter of both national and international significance.

The Zarafshan region is a broad geographical area encompassing the Samarkand, Navoiy, and part of the Jizzakh provinces. It contains the Nurata, Zarafshan, and Koratov ranges, together with a portion of the Kyzylkum desert, and is floristically notable for the coexistence of mountain, foothill (adyr), and desert ecosystems [3]. The Voha territory covers the Surkhandarya and Kashkadarya provinces and is enriched by the Hissar, Kohitang, Boysun, and Turkestan ranges. The diversity of mountain ecosystems in this territory creates unique habitats for endemic plants [6]; in particular, more than 870 plant species have been recorded within the Hissar State Nature Reserve alone, a portion of which are endemic [11].

These two regions — Zarafshan and Voha — differ considerably in their geographical and ecological characteristics. Zarafshan combines desert and mountain ecosystems, whereas Voha is dominated by a humid montane climate. In both regions, endemic plants face growing anthropogenic pressure from pasture overgrazing, the harvesting of medicinal raw materials, and land development [12]. A comparative analysis of the two regions therefore makes it possible to identify regional patterns in the distribution of endemic plants and to establish conservation priorities accordingly.

The purpose of this study is to conduct a comparative analysis of the distribution, family composition, life forms, conservation categories, and anthropogenic threat factors affecting endemic plants included in the Red Data Book across the Zarafshan region and the Voha territory. The objectives of the study are as follows: (1) to determine the taxonomic composition of endemic species in both regions; (2) to assess their distribution across conservation categories; (3) to characterize patterns of geographical distribution; (4) to construct the spectrum of life forms; and (5) to identify the principal threat factors and formulate conservation recommendations.

**Literature Review**

A number of important studies have been conducted on the flora and endemic plants of Uzbekistan. The Red Data Book of the Republic of Uzbekistan (2019) records 314 plant species, of which 83.44% are endemic [1]. The "Flora Uzbekistana" series compiled by Sennikov (2017) serves as the principal taxonomic reference for the flora of the republic [3].

Studying the botanical diversity of the Zarafshan region, Tojibaev et al. (2020) compiled an annotated checklist of endemic vascular plants of the Tian-Shan Mountains and established that more than 38 endemic species occur in the Nurata Range [7]. Lazkov (2014), examining the distribution and conservation status of endemic plants in the loess foothills of the Nurata Range, described this territory as one of the centers of endemism in Central Asia and substantiated the need for strengthened conservation measures [4].

Research conducted in the Voha territory indicates that the Hissar and Kohitang ranges are among the centers of floristic diversity in Central Asia. In their study of Important Plant Areas (IPAs) in the Fergana Valley and the Voha territory, Usmonov et al. (2022) recorded the distribution of more than 158 endemic species and found that 37.3% of them belong to conservation category 1 [6].

Usmonov et al. (2021) described the newly documented distribution range and conservation profile of Cousinia knorringiae in the Voha territory, emphasizing the need for international conservation measures [9]. A global study by Aditya and Sistha (2025) demonstrated that climate change is reducing the distribution ranges of endemic species — a finding directly relevant to the mountain regions of Uzbekistan as well [5].

Studies on the impact of anthropogenic factors on endemic flora emphasize that inappropriate pasture use and the irrational exploitation of natural resources are causing significant damage to the flora of the republic [12]. A study of rare plant species of the Fergana Valley noted that specific conservation measures have not yet been developed for many species — a challenge equally relevant to the Zarafshan and Voha regions [10].

Overall, the existing literature indicates that although the Zarafshan and Voha regions have each been well studied individually, comparative studies analyzing them within a unified methodological framework remain insufficient. Addressing this gap constitutes the scientific novelty of the present article.

**Research Methodology**

The primary data source for this study was the Red Data Book of the Republic of Uzbekistan (2019). Data were collected separately for the Zarafshan region and the Voha territory. For each species, the following parameters were recorded: species name (Latin), family, life form, conservation

category (0 — extinct, 1 — critically rare/threatened, 2 — declining, 3 — rare), and geographical distribution area.

The research methodology comprised the following stages:

1) Taxonomic analysis — species were grouped by family, and the proportion of each family relative to the total number of species was calculated;

2) Analysis by conservation category — the number and percentage of species belonging to each category were determined;

3) Analysis of life forms — species were classified into the categories of perennial herbs, annual/biennial herbs, shrubs, subshrubs, trees, and bulbous/tuberous herbs, and a biological spectrum was constructed;

4) Geographical analysis — species were distributed across mountain ranges and sub-regions, and the degree of endemism of each range was assessed;

5) Comparative analysis — species common to both regions were identified by their Latin names, and species restricted to a single region were distinguished;

6) Analysis of threat factors — based on existing literature and descriptions in the Red Data Book, the principal anthropogenic threat factors for each region were identified and their intensity qualitatively assessed (high/medium/low).

Statistical data are presented in the form of tables and percentage indicators, with results rounded to one decimal place.

**Results and Discussion**

Based on data compiled from the Red Data Book of the Republic of Uzbekistan, 92 endemic species were recorded in the Zarafshan region and 158 in the Voha territory, for a total of 250 endemic species analyzed. The Voha territory contains 1.7 times more endemic species than the Zarafshan region, confirming its status as one of the most species-rich territories of Uzbekistan.

**Table 1**

**Distribution of endemic species by conservation category**

| No. | Conservation category | Zarafshan (species) | Zarafshan (%) | Voha (species) | Voha (%) | Total (species) | Total (%) |
|---|---|---|---|---|---|---|---|
| 1 | 0 — Extinct | 0 | 0.0 | 4 | 1.6 | 4 | 1.6 |
| 2 | 1 — Critically rare (threatened) | 22 | 23.9 | 59 | 37.3 | 81 | 32.5 |
| 3 | 2 — | 37 | 40.2 | 50 | 31. | 87 | 35. |

| No. | Conservation category | Zarafshan (species) | Zarafshan (%) | Voha (species) | Voha (%) | Total (species) | Total (%) |
|---|---|---|---|---|---|---|---|
| | Declining | | | | 6 | | 0 |
| 4 | 3 — Rare | 29 | 31.5 | 45 | 28.5 | 74 | 29.7 |
| 5 | Category not assigned | 4 | 4.4 | 4 | 2.5 | 8 | 3.2 |
| | **Total** | **92** | **100** | **158** | **100** | **250** | **100** |

According to the data in Table 1, category 2 species predominate in the Zarafshan region, comprising 37 species (40.2%). Category 1 (critically rare) species account for 22 species (23.9%), and category 3 species for 29 species (31.5%). In the Voha territory, category 1 species rank first with 59 species (37.3%). This indicates that endemic species in the Voha territory are, on average, subject to greater threat than those in Zarafshan. Category 0 (extinct) species were recorded only in the Voha territory (4 species). This difference may reflect stronger anthropogenic pressure in the Voha territory, a matter examined in greater detail in the sections below.

**Table 2**

**Comparative composition of endemic species by family**

| No. | Family | Zarafshan | Voha | Total | Shared species |
|---|---|---|---|---|---|
| 1 | Fabaceae | 12 | 26 | 38 | 2 |
| 2 | Asteraceae | 13 | 25 | 38 | 3 |
| 3 | Lamiaceae | 11 | 13 | 24 | 1 |
| 4 | Apiaceae | 8 | 12 | 20 | 3 |
| 5 | Liliaceae | 7 | 11 | 18 | 5 |
| 6 | Caryophyllaceae | 7 | 7 | 14 | 2 |
| 7 | Amaryllidaceae | 3 | 8 | 11 | 0 |
| 8 | Asphodelaceae | 5 | 8 | 13 | 2 |
| 9 | Brassicaceae | 3 | 3 | 6 | 0 |

| No. | Family | Zarafshan | Voha | Total | Shared species |
|---|---|---|---|---|---|
| 10 | Other families | 23 | 45 | 68 | 7 |
| | **Total** | **92** | **158** | **250** | **25** |

The analysis presented in Table 2 shows that Asteraceae predominates in the Zarafshan region with 13 species, while Fabaceae predominates in the Voha territory with 26 species. Lamiaceae holds an important position in both regions, with 11 species in Zarafshan and 13 in Voha. Liliaceae has the highest number of shared representatives between the two regions, with 5 common species. This result indicates that the similarity of climatic conditions between the two regions favors the wide distribution of certain families; however, the relatively small number of shared species (25, or 10% of the total) demonstrates that their floristic composition differs substantially.

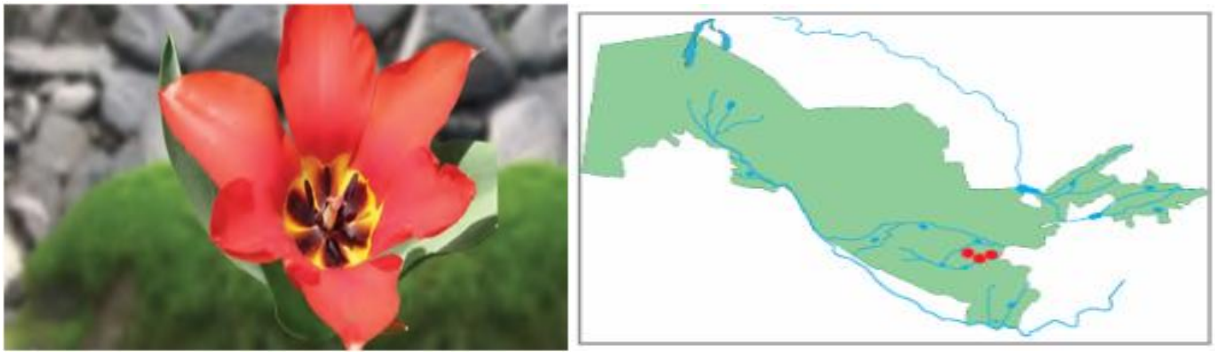


*Figure 1. Tulipa fosteriana W.Irving — Foster's tulip. A perennial bulbous herb of the family Liliaceae. An endemic species occurring in both the Zarafshan region and the Voha territory, assigned to conservation category 2. Source: Red Data Book of the Republic of Uzbekistan.*

**Table 3**

**Geographical distribution of endemic species**

| No. | Geographical area / Range | Zarafshan | Voha | Total |
|---|---|---|---|---|
| 1 | Nurata Range | 38 | 8 | 46 |
| 2 | Surkhandarya region | 11 | 108 | 119 |
| 3 | Hissar Range | 13 | 90 | 103 |
| 4 | Kashkadarya region | 17 | 68 | 85 |
| 5 | Kohitang | 8 | 42 | 50 |

| No. | Geographical area / Range | Zarafshan | Voha | Total |
|---|---|---|---|---|
| | Range | | | |
| 6 | Desert and sandy areas | 26 | 6 | 32 |
| 7 | Turkestan Range | 12 | 4 | 16 |
| 8 | Zarafshan Range | 12 | 13 | 25 |
| 9 | Boysun Range | 2 | 27 | 29 |

The results of the geographical analysis (Table 3) show that in the Zarafshan region, the Nurata Range is the richest area with 38 species, accounting for 41.3% of all species recorded in this region. The presence of 26 species in desert and sandy areas underscores the important role of the Zarafshan region in desert endemism. In the Voha territory, the Surkhandarya region (108 species, 68.4%) and the Hissar Range (90 species, 57.0%) are the richest geographical areas. This contrast is explained by differences in relief and climatic conditions between the two regions: the Zarafshan region is characterized by a sharp desert-to-mountain gradient, whereas the Voha territory is dominated by high mountain ranges.




*Figure 2. Ferula sumbul (Kauffm.) Hook.f. — Sumbul ferula. A perennial medicinal herb of the family Apiaceae. Substances extracted from its root are used in medicine. Distributed in both the Zarafshan region and the Voha territory, assigned to conservation category 3. Source: Red Data Book of the Republic of Uzbekistan.*

**Table 4**

**Analysis of endemic species by life form**

| No. | Life form | Zarafshan (species) | (%) | Voha (species) | (%) | Total |
|---|---|---|---|---|---|---|
| 1 | Perennial | 48 | 52.2 | 75 | 47.5 | 123 |

| No. | Life form | Zarafshan (species) | (%) | Voha (species) | (%) | Total |
|---|---|---|---|---|---|---|
| | herbs | | | | | |
| 2 | Bulbous and tuberous herbs | 13 | 14.1 | 24 | 15.2 | 37 |
| 3 | Shrubs | 11 | 12.0 | 12 | 7.6 | 23 |
| 4 | Subshrubs | 6 | 6.5 | 12 | 7.6 | 18 |
| 5 | Annual herbs | 4 | 4.3 | 10 | 6.3 | 14 |
| 6 | Biennial herbs | 4 | 4.3 | 7 | 4.4 | 11 |
| 7 | Trees | — | — | 5 | 3.2 | 5 |
| 8 | Other | 6 | 6.5 | 13 | 8.2 | 19 |
| | **Total** | **92** | **100** | **158** | **100** | **250** |

The analysis of life forms (Table 4) shows that perennial herbs predominate in both regions: 48 species (52.2%) in Zarafshan and 75 species (47.5%) in Voha. Bulbous and tuberous herbs rank second in both regions, represented mainly by the genera Tulipa, Colchicum, Allium, and Eremurus. Tree-form endemics (5 species) were recorded only in the Voha territory, reflecting the more humid and warmer climate of this region. This difference in biological spectrum indicates that the ecological conditions of the two regions differ substantially, and that conservation strategies should therefore be adapted to regional conditions.



*Figure 3. Eremurus robustus Regel — Giant foxtail lily. A bulbous perennial herb of the family Asphodelaceae, reaching a height of 2–3 meters. A rare species widely distributed in both the*

*Zarafshan region and the Voha territory, assigned to conservation category 3. Source: Red Data Book of the Republic of Uzbekistan.*

**Table 5**

**Endemic species common to both regions**

| No. | Family | Species (Latin name) | Zarafshan cat. | Voha cat. |
|---|---|---|---|---|
| 1 | *Ranunculaceae* | *Aconitum talassicum Popov* | 3 | 3 |
| 2 | *Caryophyllaceae* | *Allochrusa gypsophiloides (Regel) Schischk.* | 3 | 3 |
| 3 | *Fabaceae* | *Cicer grande (Popov) Korotkova* | 1 | 1 |
| 4 | *Colchicaceae* | *Colchicum kesselringii Regel* | 3 | 3 |
| 5 | *Asteraceae* | *Cousinia adenophora Juz.* | 2 | 2 |
| 6 | *Asteraceae* | *Cousinia butkovii Tscherneva* | 1 | 1 |
| 7 | *Caryophyllaceae* | *Dianthus uzbekistanicus Lincz.* | 3 | 3 |
| 8 | *Asphodelaceae* | *Eremurus aitchisonii Baker* | 3 | 3 |
| 9 | *Asphodelaceae* | *Eremurus robustus Regel* | 3 | 3 |
| 10 | *Orchidaceae* | *Eulophia turkestanica (Litv.) Schltr.* | 3 | 3 |
| 11 | *Apiaceae* | *Ferula fedtschenkoana Korovin* | 2 | 2 |

| No. | Family | Species (Latin name) | Zarafshan cat. | Voha cat. |
|---|---|---|---|---|
| 12 | *Apiaceae* | *Ferula sumbul (Kauffm.) Hook.f.* | 3 | 3 |
| 13 | *Iridaceae* | *Iris magnifica Vved.* | 2 | 2 |
| 14 | *Apiaceae* | *Komarovia anisosperma Korovin* | 1 | 1 |
| 15 | *Asteraceae* | *Lepidolopha nuratavica Krasch.* | 3 | 3 |
| 16 | *Papaveraceae* | *Paeonia hybrida Pall.* | 3 | 3 |
| 17 | *Caryophyllaceae* | *Silene oreina Schischk.* | 1 | 1 |
| 18 | *Caryophyllaceae* | *Silene popovii Schischk.* | 2 | 2 |
| 19 | *Liliaceae* | *Tulipa dasystemon (Regel) Regel* | 3 | 3 |
| 20 | *Liliaceae* | *Tulipa fosteriana W.Irving* | 2 | 2 |
| 21 | *Liliaceae* | *Tulipa ingens Hoog* | 3 | 3 |
| 22 | *Liliaceae* | *Tulipa korolkowii Regel* | 3 | 3 |
| 23 | *Liliaceae* | *Tulipa micheliana Hoog* | 3 | 3 |
| 24 | *Vitaceae* | *Vitis vinifera L.* | 3 | 3 |

| No. | Family | Species (Latin name) | Zarafshan cat. | Voha cat. |
|---|---|---|---|---|
| 25 | *Apiaceae* | *Oenanthe heterococca Korovin* | — | — |

As shown in Table 5, 25 species occur in both regions. Among these, representatives of the genus Tulipa (family Liliaceae) predominate with 5 species. Two species of the genus Ferula — F. fedtschenkoana and F. sumbul — occur in both regions. The shared occurrence of two Eremurus species — E. aitchisonii and E. robustus — indicates that these species have a comparatively wide distribution range. Species restricted to the Zarafshan region alone number 67 (72.8% of the regional total), while species restricted to the Voha territory alone number 133 (84.2%). These high percentages clearly demonstrate the floristic distinctiveness of the two regions and justify the need for region-specific conservation attention.

**Table 6**

**Representative list of critically rare (category 1) endemic species**

| No. | Species (Latin name) | Region | Category |
|---|---|---|---|
| 1 | *Astragalus nuratensis Popov* | Zarafshan | 1 |
| 2 | *Astragalus adylovii F.O.Khass.* | Zarafshan | 1 |
| 3 | *Astragalus belolipovii Kamelin* | Zarafshan | 1 |
| 4 | *Cicer grande (Popov) Korotkova* | Zarafshan and Voha | 1 |
| 5 | *Iris hippolyti (Vved.) Kamelin* | Zarafshan | 1 |
| 6 | *Komarovia anisosperma Korovin* | Zarafshan and Voha | 1 |
| 7 | *Eremurus nuratavicus A.P.Khokhr.* | Zarafshan | 1 |
| 8 | *Cousinia butkovii Tscherneva* | Zarafshan and Voha | 1 |

| No. | Species (Latin name) | Region | Category |
|---|---|---|---|
| 9 | *Silene oreina Schischk.* | Zarafshan and Voha | 1 |
| 10 | *Calligonum matteianum Drobow* | Zarafshan | 1 |
| 11 | *Allium praemixtum Vved.* | Zarafshan | 1 |
| 12 | *Onobrychis tavernierifolia Stocks* | Zarafshan | 1 |

The data in Table 6 show that, among category 1 species, representatives of the genus Astragalus (family Fabaceae) occupy a distinct position in the Zarafshan region with 3 species. Species such as Astragalus nuratensis and A. adylovii are restricted to limited areas of the Nurata Range, and their population sizes are extremely small. The occurrence of Cicer grande, Komarovia anisosperma, Cousinia butkovii, and Silene oreina in category 1 in both regions indicates that these species require immediate, dedicated conservation measures.

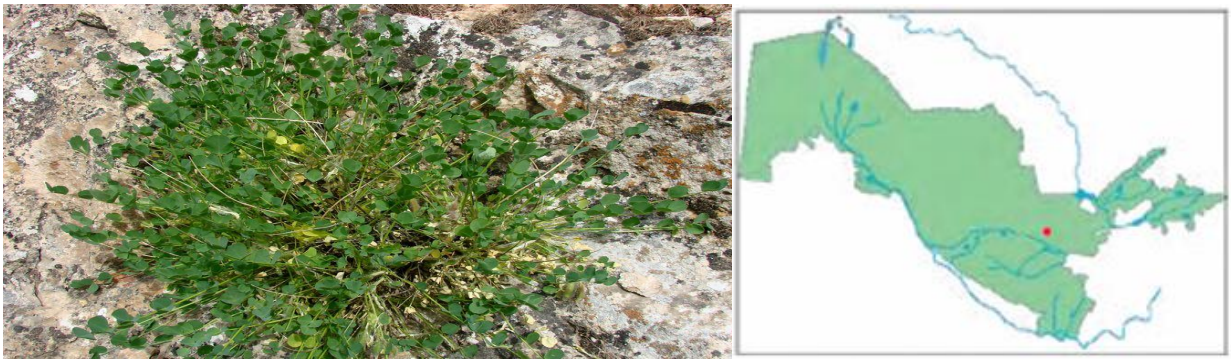


*Figure 4. Astragalus nuratensis Popov — Nurata milk-vetch. A perennial shrubby herb of the family Fabaceae. A rare endemic species restricted to limited areas of the Nurata Range and confined to the Zarafshan region. Assigned to conservation category 1 (critically rare). Source: Red Data Book of the Republic of Uzbekistan.*

**Table 7**

**Principal anthropogenic threat factors affecting endemic plants**

| No. | Threat factor | Mechanism of impact | Zarafshan | Voha |
|---|---|---|---|---|
| 1 | Pasture overgrazing | Livestock grazing reduces population density | High | High |

| No. | Threat factor | Mechanism of impact | Zarafshan | Voha |
|---|---|---|---|---|
| 2 | Harvesting of medicinal plants | Roots of Ferula and Eremurus species are excavated | Medium | High |
| 3 | Development of land and water resources | Conversion of desert and foothill areas to agriculture | High | Medium |
| 4 | Climate change and drought | Narrowing of habitat range, phenological shift | Medium | Medium |
| 5 | Road construction and infrastructure | Habitat fragmentation | Low | Medium |
| 6 | Collection of ornamental species for floriculture | Decline of Tulipa and Iris populations | Medium | Low |

The analysis of anthropogenic threat factors (Table 7) shows that pasture overgrazing is the threat factor with the highest impact level for both regions. This factor particularly affects perennial herbs and shrubs, reducing their capacity for regeneration [12]. In the Voha territory, the harvesting of medicinal plants — particularly species of the genus Ferula — is assessed as a high-level threat, since the roots of these species are valued as medicinal raw material and population recovery is slow.

In the Zarafshan region, the conversion of desert and foothill areas to agricultural use was identified as a high-level threat, posing a serious risk to desert endemics around the Mirzachul and Kyzylkum areas (for example, Calligonum matteianum). In the Voha territory, road construction and mining infrastructure in the Hissar and Kohitang ranges are leading to habitat fragmentation, assessed as a medium-level threat. The collection of ornamental species (genera Tulipa, Iris) for floriculture purposes was also found to negatively affect local populations, although this factor was assessed as relatively low in impact, since the practice is not widespread.

Overall, the identified threat factors indicate that the Voha territory is subject to greater anthropogenic pressure than the Zarafshan region, consistent with the higher proportion of category 1 (critically rare) species shown in Table 1. It is therefore recommended that conservation measures in the Voha territory be prioritized, including the introduction of a monitoring system and the expansion of the network of specially protected natural areas.

**Conclusion**

The comparative analysis of endemic plants of the Zarafshan region and the Voha territory allows the following conclusions to be drawn:

First, 92 endemic species were recorded in the Zarafshan region and 158 in the Voha territory, for a total of 250 endemic species, of which 25 occur in both regions. The Voha territory contains 1.7 times more endemic species than Zarafshan.

Second, category 2 species predominate in the Zarafshan region (40.2%), whereas category 1 species predominate in the Voha territory (37.3%). Category 0 (extinct) species were recorded only in the Voha territory, indicating that the endemic flora of this territory is, on the whole, subject to greater threat.

Third, in terms of family composition, Asteraceae predominates in Zarafshan, while Fabaceae predominates in Voha.

Fourth, geographical analysis shows that the Nurata Range (38 species) and desert areas (26 species) are the richest areas in Zarafshan, whereas the Surkhandarya region (108 species) and the Hissar Range (90 species) are the richest areas in Voha.

Fifth, perennial herbs predominate in both regions, while tree-form endemics were recorded only in the Voha territory.

Sixth, pasture overgrazing and the harvesting of medicinal plants were identified as the most significant anthropogenic threat factors for both regions, with this impact being relatively stronger in the Voha territory.

The results obtained may serve as a scientific basis for developing conservation strategies for endemic plants, strengthening monitoring systems, and expanding the network of internationally coordinated protected areas. For future research, long-term monitoring of the population dynamics of each category 1 species and distribution modeling using GIS technologies are recommended.

**References**

1. Red Data Book of the Republic of Uzbekistan. Vol. 1. Tashkent, 2019. (In Uzbek).
2. Red Data Book of the Republic of Uzbekistan. Vol. 1. Tashkent, 2016. (In Uzbek).
3. Sennikov, A. N. Flora Uzbekistana [Flora of Uzbekistan]. Vol. 2. Tashkent: Navruz, 2017. (In Russian).
4. Lazkov, G. A. Endemic Plants of the Nurata Mountains. Bishkek: Ilim, 2014.
5. Aditya, Henu Sistha. "Climate Crisis and Biodiversity: A Study on the Loss of Habitat and Endemic Species." KnE Social Sciences, vol. 10, no. 26, 2025, pp. 358–363, https://doi.org/10.18502/kss.v10i26.20013.
6. Usmonov, M., et al. "Important Plant Areas (IPAs) in the Fergana Valley (Central Asia): The Badlands of the Northern Foothills." Nature Conservation, 2022, https://doi.org/10.3897/natureconservation.48.84834.

7. Tojibaev, K., et al. "An Annotated Checklist of Endemic Vascular Plants of the Tian-Shan Mountains in Central Asian Countries." Phytotaxa, vol. 464, no. 2, 2020, https://doi.org/10.11646/phytotaxa.464.2.1.

8. UNDP. Conservation of Globally Important Biodiversity and Associated Land and Forest Resources of Western Tian Shan. 2021.

9. Usmonov, M., Tojibaev, K., Jang, C.-G., Sennikov, A. N. "Species Conservation Profile and Amended Distribution of Cousinia knorringiae (Asteraceae)." Biodiversity Data Journal, vol. 9, 2021, e64115, https://doi.org/10.3897/BDJ.9.e64115.

10. Holdarov, J., et al. Farg'ona vodiysi kamyob o'simlik turlari atlas-lug'ati [Atlas Dictionary of Rare Plant Species of the Fergana Valley]. Farg'ona, 2021. (In Uzbek).

11. Protected Natural Areas of the Republic of Uzbekistan. Data of the Hissar State Nature Reserve. State Committee for Ecology and Environmental Protection. Tashkent, 2022. (In Uzbek).

12. Ministry of Ecology, Environmental Protection and Climate Change of the Republic of Uzbekistan. Information on Specially Protected Natural Areas. Tashkent, 2023. (In Uzbek).

13. Mirzayeva, O., G'afurova, O'. "O'zbekiston respublikasi qizil kitobiga kiritilgan bir urug'pallali endemik o'simliklar" [Monocotyledonous Endemic Plants Included in the Red Data Book of the Republic of Uzbekistan]. NamDU Ilmiy Axborotnomasi, no. 1, 2026, pp. 95–100. (In Uzbek).