GEOSPATIAL DISTRIBUTION AND DOMINANCE PATTERNS OF LEADING GENERA IN THE GRID MAPPING OF THE FLORA OF CENTRAL UZBEKISTAN

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Abstract: *Central Uzbekistan is a major floristic region where grid mapping provides an effective approach for systematizing plant distribution data. Using more than 10,000 georeferenced records across 2,878 grid cells (5 × 5 km), we analyzed spatial patterns and dominance structures of the leading polymorphic genera represented by over 530 species from 10 major taxonomic groups. The regional flora comprises 646 genera, with Astragalus being the most diverse (156 species, 3,209 specimens, presence in 445 grid cells). The top 10 genera account for 20% of all species and 20.3% of herbarium records. Astragalus, Allium, Cousinia, Gagea, and Ferula form the core of the flora, jointly ranking first in more than half (51.1%) of all grid cells.*

Keywords: *Central Uzbekistan, Biodiversity, Floristic mapping, Species richness, Collection density*

INTRODUCTION

Grid mapping has become one of the most widely used methods in international floristic research, as it ensures precise documentation of plant spatial distribution, systematic standardization of floristic data, and preservation in a format suitable for statistical analyses (Seregin, 2013). Today, this approach is well established in many countries, particularly across Europe, where it is applied in national flora monitoring and the development of biodiversity atlases (Shcherbakov et al., 2021). Modern distribution maps of vascular plants in the United Kingdom, Austria, Italy, Spain, and France are based on grid mapping, providing centralized and reliable floristic datasets (Van Landuyt, 2012).

The proper organization of floristic inventories is essential not only for documenting plant diversity but also for evaluating responses to anthropogenic pressures, landscape transformations, and ecological processes. Taxonomic and biogeographical studies rely heavily on high-quality floristic data, as accurate species identification, spatial distribution, and ecological placement form the basis for subsequent scientific analyses (Wagensommer, 2023). Determining the spatial structure of flora further provides critical insights for nature conservation strategies (Villaseñor, 2022; Haq et al., 2023).

Although the flora of Central Asia, including Uzbekistan, has long been studied, grid-based floristic research has rapidly advanced in recent years. Within the 2025–2029 state program Digital Nature, a major objective is the creation of a digital platform for the flora of Central Uzbekistan. One of the key components of this initiative is the development of an updated botanical-geographical regionalization map of Central Asia and a comprehensive analysis of plant diversity through grid mapping. Examining the geospatial distribution of polymorphic genera key components of natural flora and assessing their dominance patterns within the grid system represent central elements of this research.

Methods

A geo-referenced floristic database containing more than 530 plant species from 10 leading genera and comprising approximately 10,040 rows (MS Excel format) was used in the study. The data were integrated into a grid mapping system of Central Uzbekistan consisting of 2,878 squares, each measuring 5 × 5 km. Grid construction was performed using ArcGIS v10.6.1 (ESRI Inc., Redlands, CA, USA), with WGS 1984 applied as the coordinate reference system (Shcherbakov, 2021). Each grid cell was labeled with index codes composed of Latin letters and numbers (Seregin, 2014). Species richness was determined based on the number of species recorded in each 5 × 5 km cell (Schmidt, 2014). Collection density was calculated according to herbarium records available per grid cell (Van Landuyt, 2012; Vollering et al., 2016). Classification of grid cells by species richness and sample size followed the recommendations of Juramurodov I. (2025).

Results

A total of 646 genera have been recorded in the natural flora of Central Uzbekistan, with an average of four species per genus. The number of monotypic genera in the flora is 298, represented by Acanthosepalus, Achnatherum, Adiantum, Aethionema, Agriophyllum, Agrostemma, Ailanthus, and others. Analyses based on the number of species, the quantity of collected specimens, and the number of grid indices in which they occur clearly demonstrate the dominance of the genus Astragalus. This genus is represented by 156 species in the flora of Central Uzbekistan and stands out as the richest and most dominant genus. A total of 3,209 herbarium records of Astragalus species have been documented across the grid map indices, and their geospatial distribution covers 445 (35.7%) indices. Next in rank by species richness and distributional indices is Allium, while by the number of specimens, representatives of the genus Cousinia occupy the subsequent position. The ten leading genera in the flora collectively comprise 515 species (20%), forming the major share of the total flora. In terms of herbarium records, these genera contain 9,146 specimens, accounting for 20.3% of all records. According to Kamelin (1973), the general sequence of polymorphic genera for the Mountain Central Asian province is Astragalus, Allium, Cousinia, Gagea, and Ranunculus. In the flora of Central Uzbekistan, a slight modification of this spectrum is observed, with Ranunculus and Gagea switching positions, resulting in the sequence Astragalus, Allium, Cousinia, Ranunculus, and Gagea (Table 1).

Table 1. Key Floristic Indicators of Polymorphic Genera

№	Genus	Number of Species	Number of Specimens	Number of Indices
1	*Astragalus*	156	3209	445
2	*Allium*	66	831	323
3	*Cousinia*	63	1145	291
4	*Ranunculus*	40	906	276
5	*Gagea*	37	801	252
6	*Veronica*	34	670	240
7	*Silene*	33	682	239
8	*Carex*	32	662	228
9	*Salvia*	31	556	215
10	*Polygonum*	30	575	207

According to the results of the analysis, the genera Astragalus, Allium, Cousinia, Gagea, and Ferula were found to be dominant across the grid indices in terms of species number within the flora of Central Uzbekistan.

These ten genera occupy the first place in 637 out of the 1,246 indices and are dominant in 51.1% of all indices (Table 2). The genus Astragalus is dominant in one-fifth (20.1%) of all indices and represents not only the largest genus in terms of species number but also the most extensive in terms of geographical distribution.

The genera Allium (9.5%) and Gagea (4.6%) follow Astragalus, forming the major genera in the floristic composition based on species number.

Although the genera Cousinia, Ferula, Carex, Silene, Salvia, Veronica, and Polygonum dominate a comparatively smaller proportion of the indices, they still contribute substantially to the floristic structure.

A noticeable difference is observed between the list of the top ten genera ranked by species richness and the ten dominant genera occupying the first position in the indices. In particular, although Ranunculus ranks fourth in species richness, it does not appear among the dominant genera; instead, its place is taken by Ferula.

№	Genus	Number of Dominant Indices	Percentage (%)
1	*Astragalus*	250	20.1
2	*Allium*	118	9.5
3	*Gagea*	57	4.6
4	*Cousinia*	52	4.2
5	*Ferula*	33	2.6
6	*Carex*	30	2.4
7	*Silene*	27	2.2
8	*Salvia*	25	2.0
9	*Veronica*	23	1.8
10	*Polygonum*	22	1.8
11	Total	637	51.1

Table 2. Genera Dominant in Terms of Species Number Across Grid Indices

The results of the study indicate that the genera Astragalus, Allium, Gagea, and Cousinia consistently dominate in terms of species number and are widely distributed across the entire region (Figure 1). Therefore, these genera represent important structural units within the flora of the area, forming a major component of its floristic diversity.

In the majority of indices with high species richness such as those corresponding to the territory of the Hisor State Reserve representatives of Astragalus prevail. Only a few grid cells within the reserve show Cousinia and Allium as relatively dominant genera.

The dominance of Astragalus in the index floras reflects a natural pattern typical for the mountainous provinces of Central Asia and mirrors the general floristic regularities of the region. However, the dominance of other genera particularly Polygonum, Salvia, and Veronica in certain indices may indicate that the floristic composition of these cells has not been sufficiently studied or that existing data remain incomplete.

At the same time, in some indices with distinctive ecological and topographic conditions, the dominance of particular genera is also possible. This reflects floristic peculiarities shaped by microclimatic differences and local ecological factors within the region.

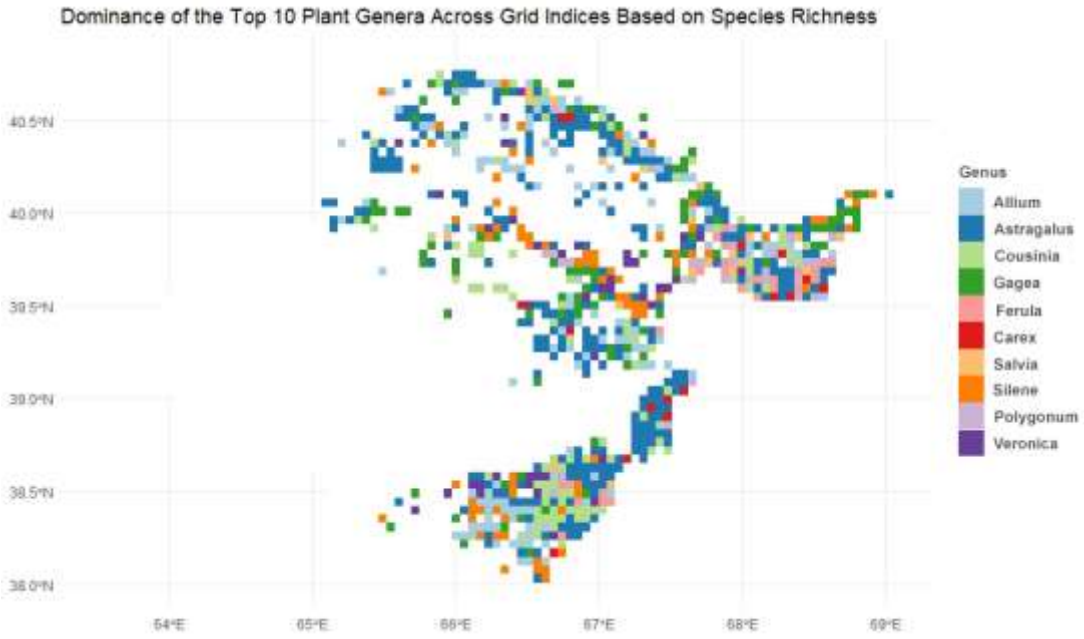

Figure 1. Dominance Level of Polymorphic Genera Across Grid Indices

Conclusions

Polymorphic genera play a key structural role in the flora of Central Uzbekistan. A total of 646 genera have been recorded, with an average of four species per genus. Nevertheless, 298 genera are represented by only a single species, indicating a high degree of floristic mosaicity.

The analyses confirmed the absolute dominance of the genus Astragalus: with 156 species, 3,209 herbarium records, and 445 indices, it is the largest and most widely

distributed genus in the flora. Its being ranked first in 20.1% of all indices demonstrates not only its high species richness but also its geographical stability.

Polymorphic genera are not evenly distributed across ecotopes. Although Astragalus is dominant in the Hisor State Reserve, in certain grid cells Cousinia or Allium take the leading position due to local ecological factors. Overall, the genera Astragalus, Allium, Gagea, and Cousinia constitute the core of the region’s flora and play an important role in its stability.

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