

Analysis of the Most Widespread Species in the Flora of the Western Pamir-Alay within Surkhandarya Region

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The degree to which species are distributed across a flora is an important indicator characterizing its spatial structure, as it makes it possible to determine the ratio between taxa with broad and restricted spatial coverage [1]. Analysis of geographically referenced floristic data using a grid system provides a basis for comparing the spatial frequency and coverage of each species by counting the grid cells (indices) in which it has been recorded [2]. However, the spatial distribution of herbarium records may be uneven because of differences in collection intensity, the degree to which areas have been surveyed, and taxonomic coverage. Therefore, the number of grid cells does not represent the absolute geographic range of a species; rather, it reflects the spatial coverage documented by the available data [3, 6].

The results of grid-based mapping revealed substantial differences in the spatial coverage of species within the flora of the study area. Of the 2,202 species recorded, 321 (15%) were found in only one grid cell, while 809 species (36.7%) occurred in 2–10 cells, 678 (31%) in 11–50 cells, and 199 (9%) in 50–100 cells. Only 177 species (8%) were recorded in more than 100 cells. This distribution indicates that the spatial structure of the flora comprises a relatively small group of widely distributed species and a majority of taxa with comparatively restricted spatial coverage. *Plantago lanceolata* had the greatest spatial coverage, being recorded in 307 grid cells (35%) and represented by 541 herbarium specimens. *Poa bulbosa* (302 cells, 542 specimens) and *Convolvulus arvensis* (299 cells, 439 specimens) showed similarly high values (Fig. 1).

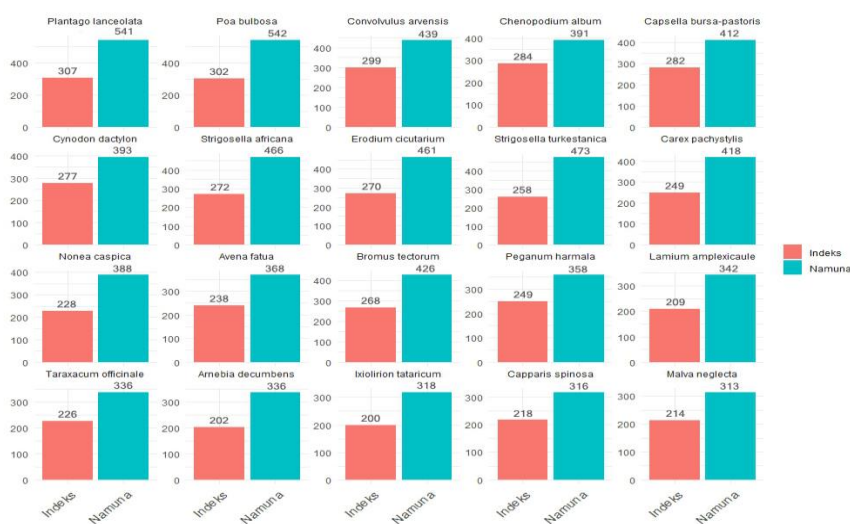


Fig. 1. Distribution of the species with the greatest spatial coverage according to grid-based mapping, by number of grid cells and herbarium specimens

Chenopodium album, *Capsella bursa-pastoris*, *Cynodon dactylon*, *Strigosella africana*, and *Erodium cicutarium* also occurred in more than 270 grid cells, placing them among the leading species in terms of broad geographic distribution. At the same time, species rankings based on grid-cell coverage do not fully correspond to rankings based on the number of herbarium specimens. *Plantago lanceolata* ranks first in spatial coverage, whereas *Poa bulbosa* has a higher specimen count despite being recorded in fewer grid cells. This demonstrates that the extent of a species' distribution should primarily be assessed by the number of grid cells in which it has been recorded, rather than by the volume of collection data alone [5].

The grid-cell coverage analysis also revealed substantial differences among genera. The genus *Astragalus* had the greatest spatial coverage, with 2,547 herbarium specimens recorded across 515 grid cells. This represents 58% of all grid cells. *Convolvulus* ranked second, with 881 specimens recorded in 397 cells. Among the ten leading genera, *Gagea* was represented by 799 specimens recorded in 238 cells (Fig. 2).

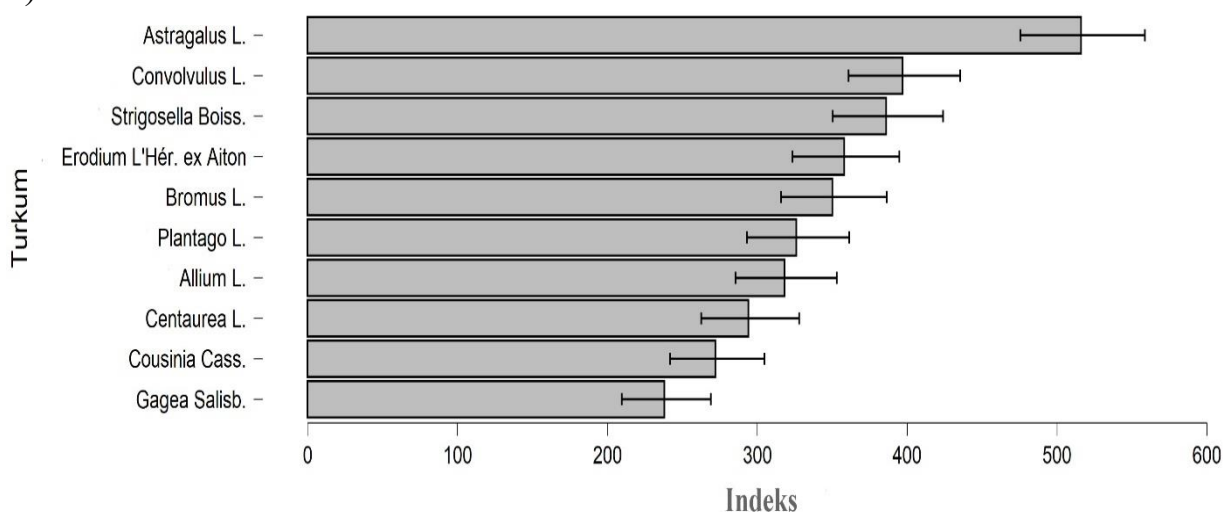


Fig. 2. Distribution of the genera with the greatest spatial coverage according to grid-based mapping, by number of grid cells and herbarium specimens

The relationship between the numbers of grid cells and herbarium specimens for Astragalus, Convolvulus, and Gagea shows that the spatial coverage of genera does not vary in direct proportion to the volume of collection data. In particular, the occurrence of Astragalus in 515 grid cells indicates that its representatives are widely distributed throughout the study area. By contrast, the relatively large number of herbarium specimens of Gagea concentrated in fewer cells indicates a higher spatial concentration of collection records. Thus, when comparing the geographic distribution

of genera, coverage across grid cells—not the absolute number of specimens—is the principal spatial criterion.

The difference between spatial coverage and collection density identified at the genus level was also clearly evident at the family level. Among the leading families, Fabaceae had the broadest coverage, with its representatives recorded in 721 grid cells, equivalent to 81% of all grid cells. It was followed by Asteraceae, with 671 cells (76%); Poaceae, with 643 (73%); and Brassicaceae, with 641 cells (72%) [4]. These results indicate that the four leading families are widely distributed throughout the study area, although the density of their collections varies among grid cells. The maximum number of herbarium specimens was recorded for Fabaceae in cell W196 (96 specimens), Asteraceae in W193 (106), Poaceae in E198 (90), and Brassicaceae in S215 (72) (Figs. 3–6). Thus, the geographic coverage of the leading families does not fully coincide spatially with the maximum density of herbarium collections. Grid-cell coverage reflects the distribution of family representatives across the study area, whereas the maxima in collection density (CD) indicate a high concentration of records in particular grid cells.

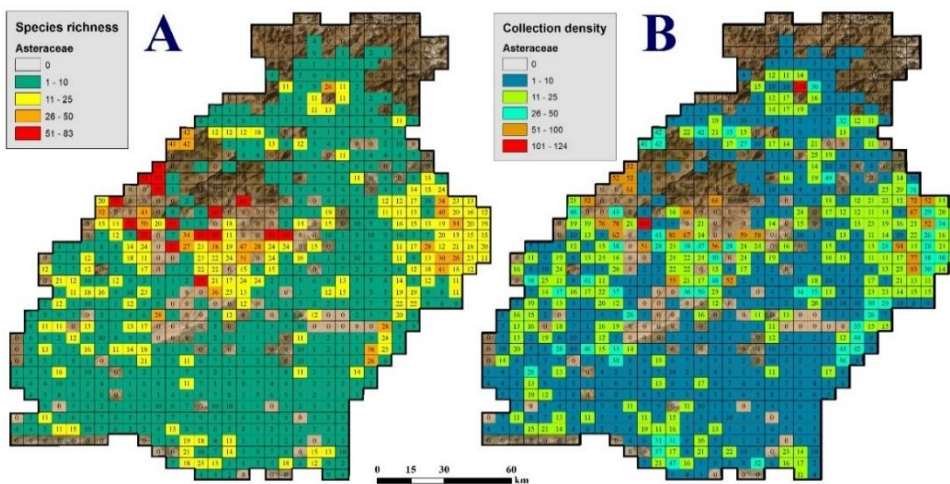


Fig. 3. Grid-based map of the family Asteraceae: species diversity across grid cells (A) and collection density (B)

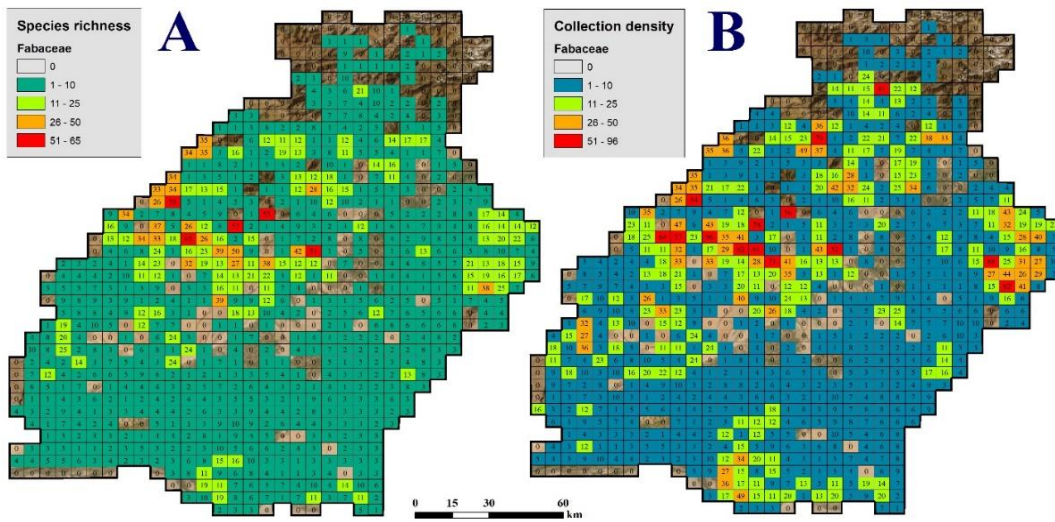


Fig. 4. Grid-based map of the family Fabaceae: species diversity across grid cells (A) and collection density (B)

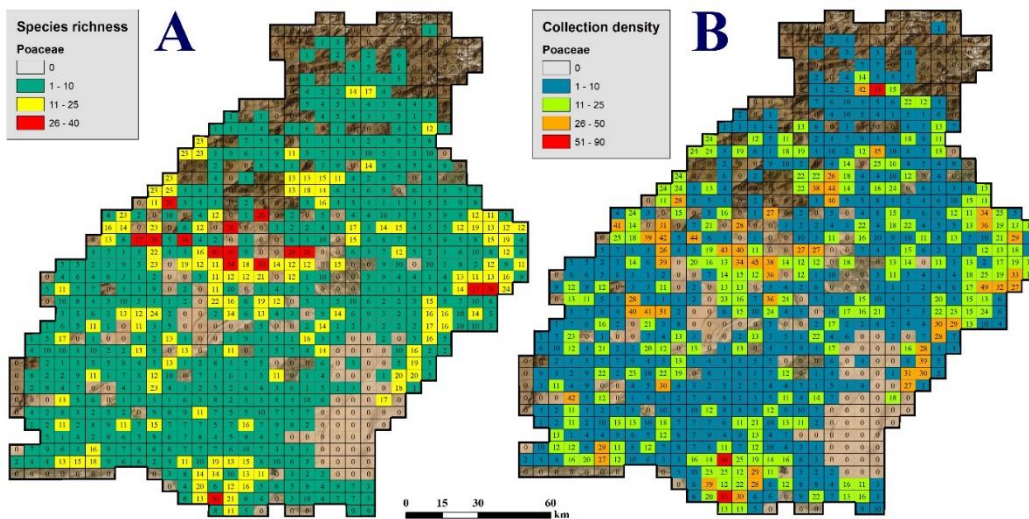


Fig. 5. Grid-based map of the family Poaceae: species diversity across grid cells (A) and collection density (B)

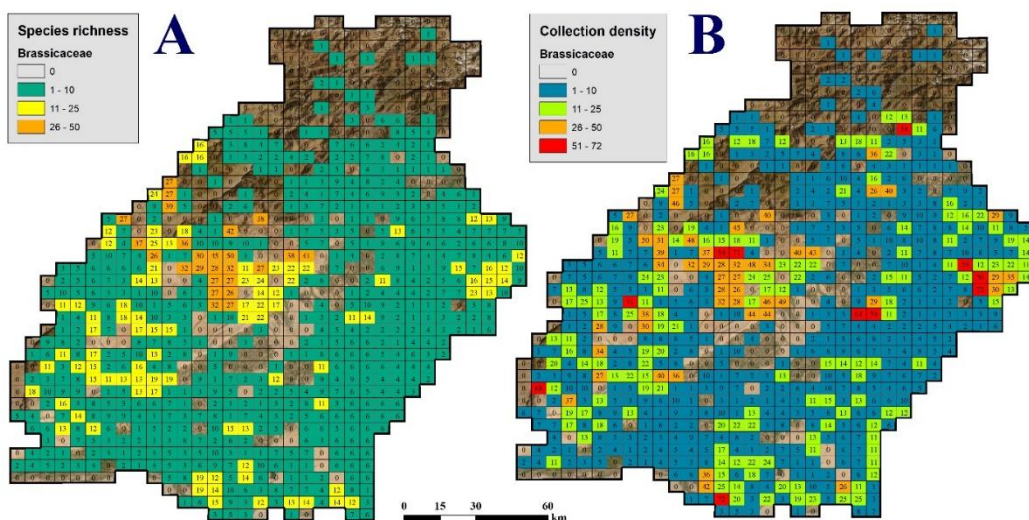


Fig. 6. Grid-based map of the family Brassicaceae: species diversity across grid cells (A) and collection density (B)

Based on the results obtained, it can be concluded that the flora of the study area has a clearly differentiated structure in terms of the spatial coverage of its taxa. Most species were recorded in a limited number of grid cells, while species with broad spatial coverage constituted a comparatively small group. This indicates the numerical predominance of taxa with local or relatively restricted distributions. Comparative analyses at the species, genus, and family levels showed that spatial coverage and the density of herbarium collections do not fully correspond. This indicates that the broad distribution of taxa is not directly determined by the quantity of collected material; spatial coverage and collection density characterize different aspects of floristic data. The results support the conclusion that the spatial structure of the flora in the study area is characterized, on the one hand, by the numerical predominance of species with restricted coverage and, on the other, by a relatively low proportion of widely distributed taxa, alongside broad geographic coverage among certain major taxonomic groups.

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