Scientific Research Publishing

American Journal of Plant Sciences, 2024, 15, 1100-1112
https://www.scirp.org/journal/ajps
ISSN Online: 2158-2750
ISSN Print: 2158-2742

An Analysis of Ephemeral Species in the Fergana Valley Region of the Republic of Uzbekistan According to Grid Mapping

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How to cite this paper: Orzimat, T.T. and Khulkaroy, K.A. (2024) An Analysis of Ephemeral Species in the Fergana Valley Region of the Republic of Uzbekistan According to Grid Mapping. *American Journal of Plant Sciences*, **15**, 1100-1112.
https://doi.org/10.4236/ajps.2024.1512070

Received: September 11, 2024
Accepted: November 24, 2024
Published: November 27, 2024

Abstract

Using herbarium specimens kept at the Institute of Botany of the Academy of Sciences of the Republic of Uzbekistan and the results of our field studies conducted during 2020-2023, we identified 214 types of species of ephemeral plants that belong to 20 families, 105 species, which grow in the Fergana Valley of the Republic of Uzbekistan, and studied 8317 herbarium specimens. Taking into consideration the fact that to date, no individual research work has been conducted on the ephemeral plants of the Fergana Valley, no grid maps have been created, we demonstrated the grid map of the Fergana Valley, species diversity of indices, accumulations density of indices, distribution of indices by species richness, distribution of indices by accumulations density, distribution of the leading families on the grid map indices, species richness by leading families, accumulation density on leading families, a grid map by species diversity of Brassicaceae, Asteraceae, Boraginaceae, Fabaceae, Poaceae family, and a grid map on accumulation density of Brassicaceae, Asteraceae, Boraginaceae, Fabaceae, Poaceae family. The results obtained allow the conservation of species and their use for many years.

Keywords

Fergana Valley, Ephemeral, Herbarium, Species, Genus, Botanical-Geographic Region, Flora, Ecology, TASH

1. Introduction

Ephemeral species are an ecological group of annual herbaceous plants that complete a full development cycle in a very short and usually humid period (from 2 - 6 weeks

to 5 - 6 months). They develop In Uzbekistan conditions mainly in early spring (February - May), using the time before the onset of drought. The so-called winter ephemera begins to develop in autumn. Ephemera belong to mesophytes, but have heat-resistant seeds. Depending on meteorological conditions, the germination time, life span and size of plants vary greatly; ephemera are often very low (1 - 3 cm).

In modern floristic studies, various methods are used to assess the geographical distribution of species, and biodiversity [1]. The method of Grid mapping of local flora, which began in Western European countries in the second half of the 20th century [2] is now gaining worldwide popularity as the most perfect method of studying and bio-documentation of plant diversity [3]. The initial Grid Map for the flora of Uzbekistan was developed for the western branches of the Zarafshan range in 2018 and U.H. Kodirov successfully defended his PhD dissertation work on the topic of "Flora of the Urgut Botanical-geographical region" [4]. Based on these experiments, it was for the first time in the Central Asian countries that a grid map of the flora of Uzbekistan, consisting of 19,240 indices with an area of 5 × 5 km each was created in 2021 [5]. Grid mapping allows to concentrate a complex of scattered data into one system, visualize them using modern technologies and software packages (to reflect the spatial location of species on maps, prepare infographics), quickly and qualitatively conduct data exchange, and the main thing to universalize floristic research works [6]. The most important criteria for grid mapping are description of areas with minimal to maximum species richness, endemism, and species in need of protection [7]. 907 of the existing indices on the grid map of the flora of Uzbekistan correspond to the Uzbekistan part of the Fergana Valley (**Figure 1**).

Together with this, there has also been a lot of research on the study of plant communities in different regions of Uzbekistan [8]-[14].

2. Research Methods

The work used herbarium specimens collected during field research in different regions of the Fergana Valley in 2019-2024, as well as specimens collected in the period 1913-2023 stored in the National Herbarium of Uzbekistan (TASH) and the Herbarium of Moscow State University (MW). Species names are taken according to the generally accepted International Index of Plant Names (https://www.ipni.org/), World Catalog of Plant Life (https://www.catalogueoflife.org/). When creating a list of plants, we used field research carried out to date, herbarium specimens stored in funds and the list given by V. A. Burygin, L. E. Markova (1975). In this work, it is indicated distribution of indices by species richness, distribution of indices by accumulations density, distribution of the leading families on the grid map indices, species richness by leading families. The research used universally accepted techniques (Grid mapping 1 × 1) [3].

3. Results

During the studies, we analysed 8317 geo-associated herbarium data of 214 types

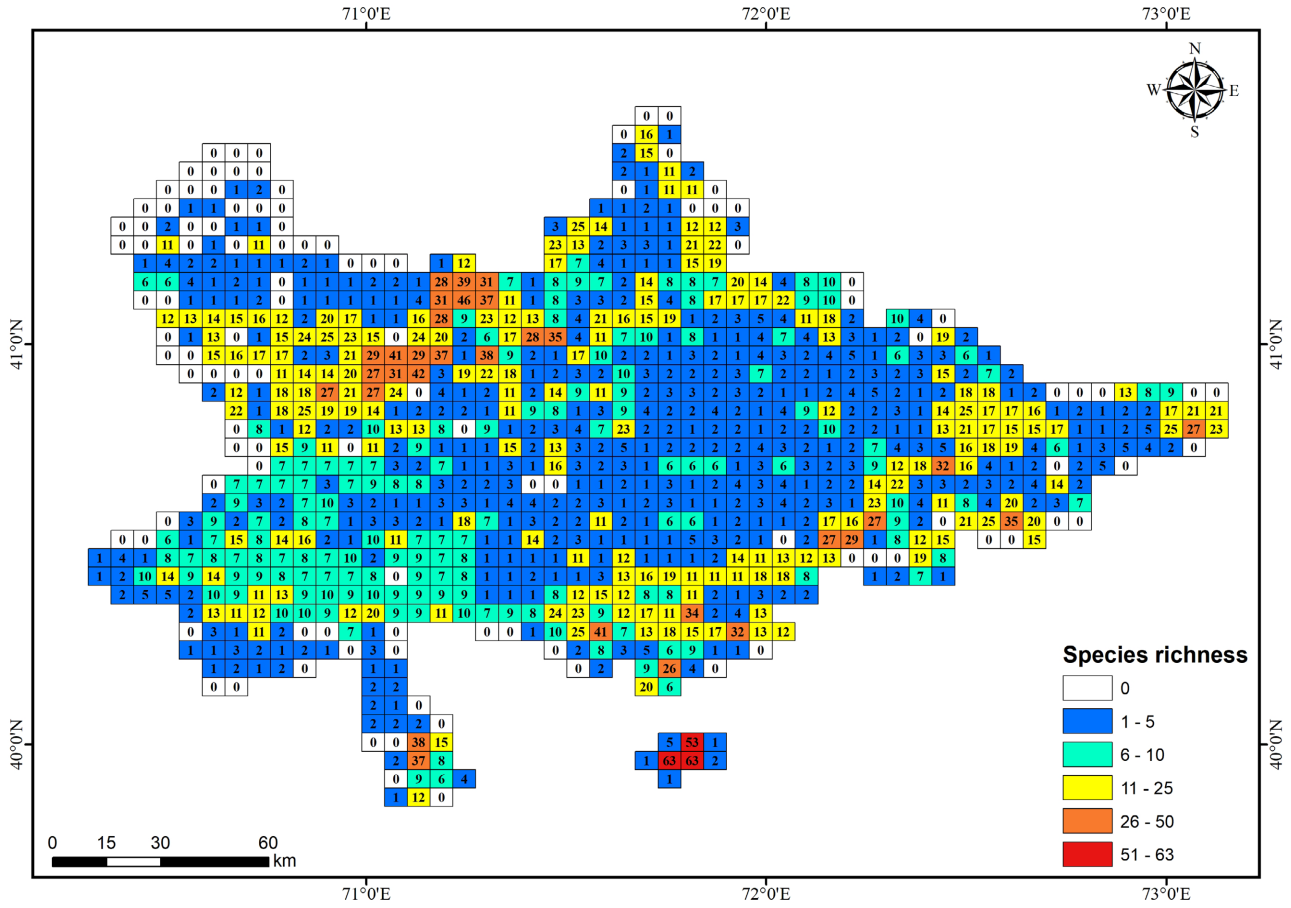

Figure 1. Grid Map of Fergana Valley.

that belong to 20 families, 105 species, which are present in the flora of the Fergana Valley, in a cross-section of the grid map indices. According to the spatial location, the herbarium samples of ephemeras took 797 (89%) indices on the grid map (Figure 1).

The average species diversity of the indices made 8 species; the density of accumulations made 10 herbarium specimens. The maximum species richness score was 63, corresponding to the indexes BI277, BI278 (Shohimardon). Also, according to the accumulation density, the BI277 square leads with 226 herbarium samples, the next result belongs to the BQ278 index, which hosts 151 herbarium samples. The indicators on the species richness on the grid map indices of Fergana Valley ephemeras (*species richness*) and the number of herbarium specimens (*accumulation density)* are given in Figure 2.

On the grid map, 110 (11%) squares have a value of "0", so no data about ephemeras are given on such. The peak indicator corresponds to indices with species richness in the range 1 - 5. There are 428 of them, which makes 47% of the squares. There are 3 indices with the highest species diversity, with a score of 51 - 63. Distribution of indices according to the degree of species richness is given in Figure 3.

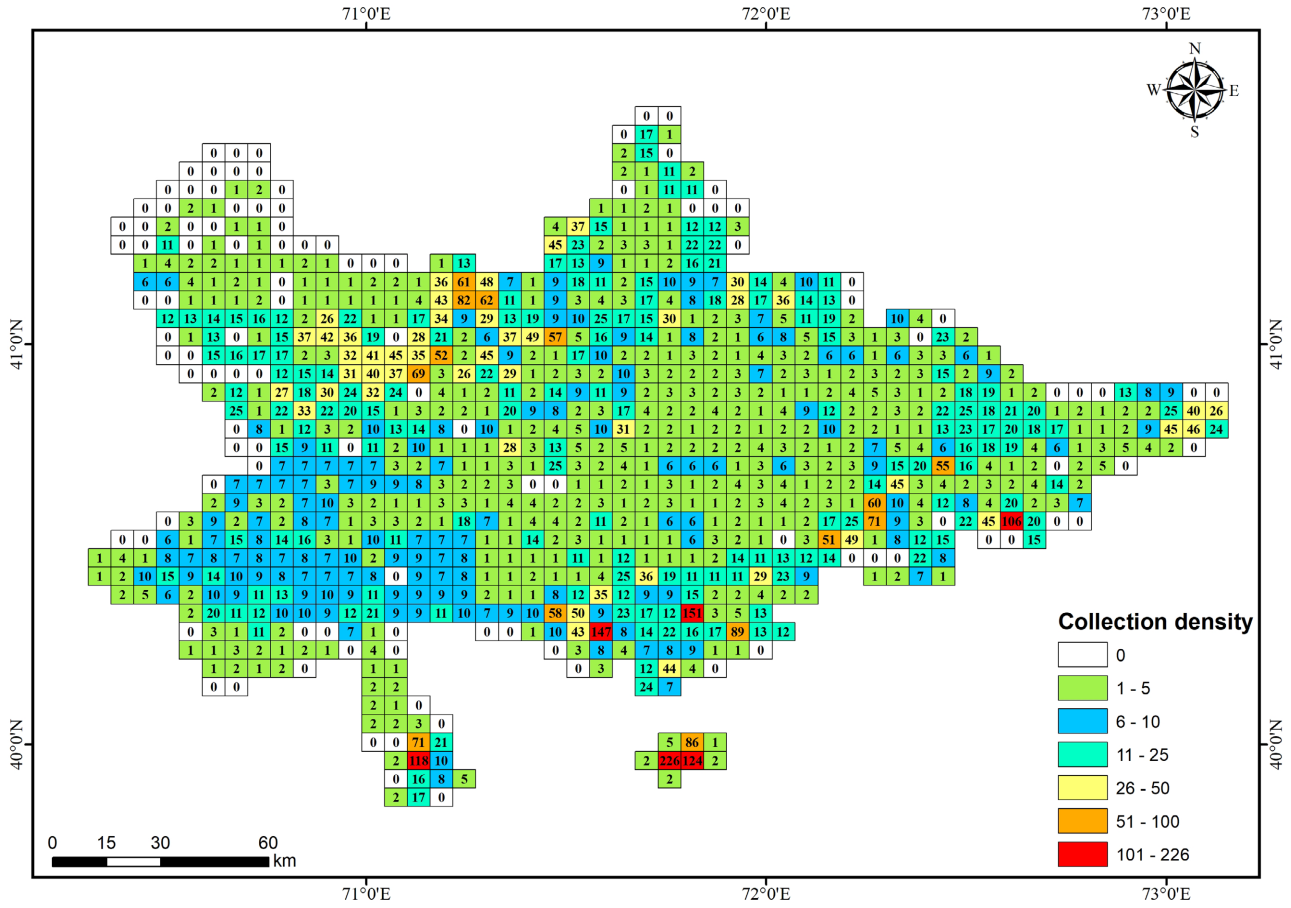

Figure 2. Accumulations density of indices.

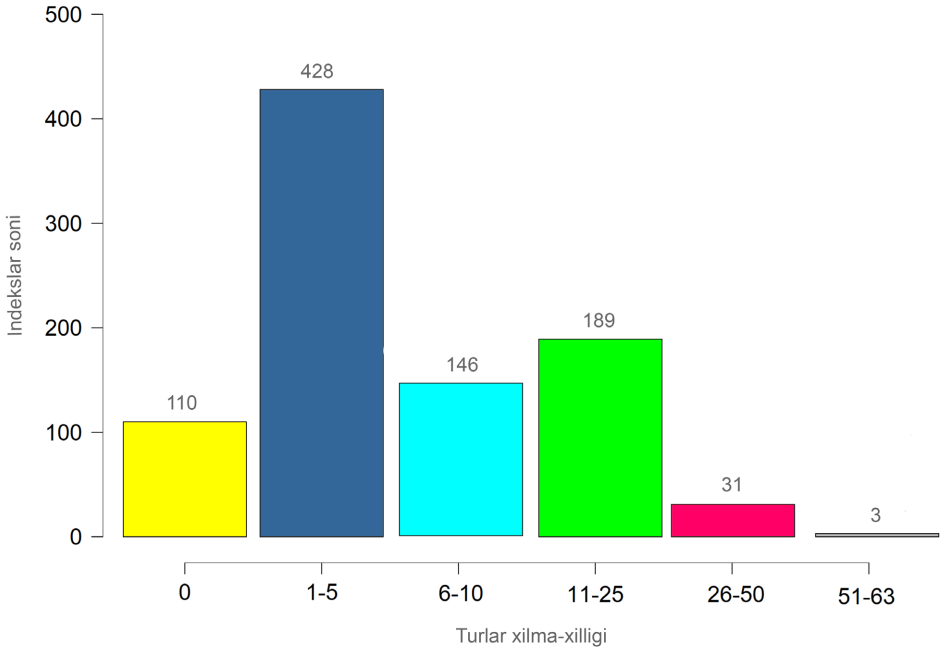

Figure 3. Distribution of indices by species richness.

Bromus, *Strigosella*, *Erodium*, *Medicago* and *Roemeria* are the most common categories, the following examples of which are on the grid map are shown: *Bromus* in 281, *Strigosella* in 274, *Erodium* in 247, *Medicago* in 217 and *Roemeria* in 214 squares. *Nonea capsica*, *Casella bursa-pastoris*, *Bromus tectorum* and *Strigosella Africana* the most common species among ephemeras. So, *Nonea capsica is noted* in 248 indices, *Capsella bursa-pastoris* in 247, *Bromus tectorum* in 238 and *Strigosella Africana* in 219 indices. Also, according to the degree of accumulations density, there are 110 indices with a value of "0" (11%). The highest indicator of the herbarium samples belongs to indices that are equal to 1-5, there are 417 of them (46%). Other results on the degree of accumulations density are given in.

4. Discussion

By the number of accumulations, the leading categories are *Roemeria*—502, *Medicago*—460, *Bromus*—372, *Strigosella*—365 and *Erodium*—351. The sequence of species in which the most herbarium data has been collected is: *Bromus tectorum*—368, *Capsella bursa-pastoris*—359, *Nonea capsica*—340 and *Strigosella africana*—302 occurrences.

The main characteristics of natural flora are also reflected in polymorphic families that are leading in it. Therefore, during the study we carried out an analysis of families that are considered polymorphic among ephemeras. In the separation of polymorphic families, the number of species in their composition was taken as a basis. According to this basis, the Brassicaceae, Asteraceae, Boraginaceae, Fabaceae and Poaceae families take the leading position. This sequence is different from the indicator, which is characteristic of the Central Asian local floras. The first four of the leading families for the natural flora of Central Asia mostly consist of Asteraceae, Fabaceae, Poaceae, and Brassicaceae, while Boraginaceae usually is not even in the top five (Kamelin 1973, p. 373). The top five of the leading families were differentiated as part of the Fergana Valley ephemera, and the species diversity in them is given in **Figure 4**.

For the purposes of analysis, the first five polymorphic families with high species richness were taken from amongst the families. According to Kamelin's theory (1973), the first four usually embody those aspects, specific to the general flora, since the species diversity of Fabaceae and Poaceae among the ephemeras is the same, we conducted a study based on the first five. Among polymorphic families, the Brassicaceae (40 species) family species are at the forefront of species diversity. The top five of the leading families accounted for 58% of the total species. 62% of the total herbarium data used in the study, and 5178 specimens belong to polymorphic families (**Figure 5**). According to the scope of herbarium data, Brassicaceae is in the leading position, there are 1459 samples in it. The next position corresponds to the share of Boraginaceae (1109 samples), the lowest degree among the first five belongs to representatives of the Fabaceae family (616 samples).

Polymorphic families occur in 81% (732) of the grid map indices. The family

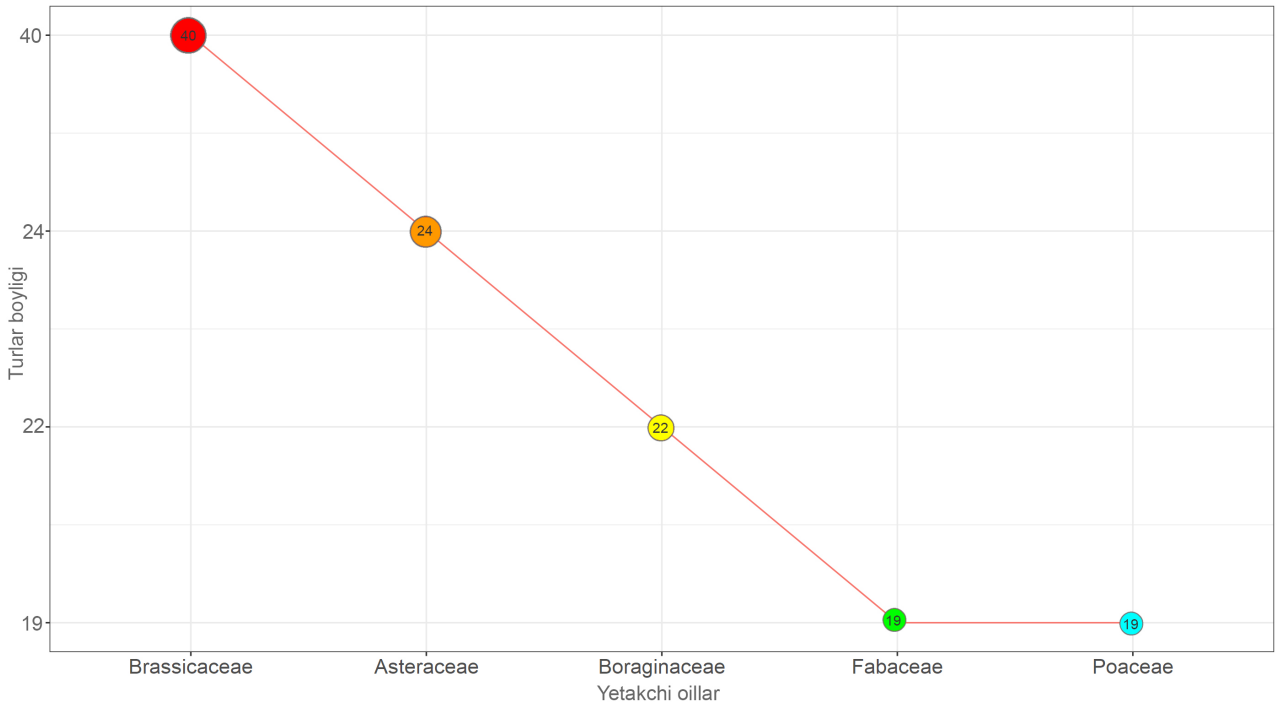

Figure 4. Species richness by leading families.

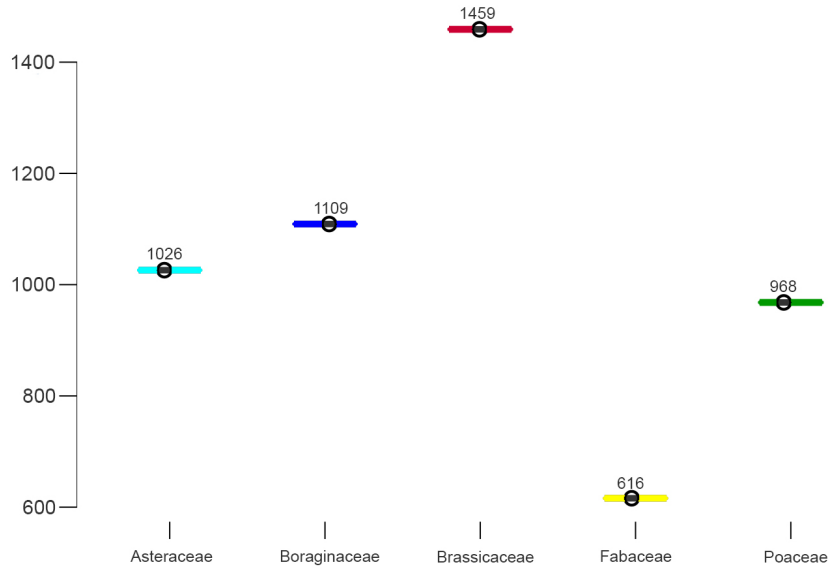

Figure 5. Accumulations density by leading families.

with the largest scale distribution, Brassicaceae, is distributed in 54% of the indices (491). Boraginaceae family is found in 419 squares, Asteraceae in 355 squares, Poaceae in 355 squares, and Fabaceae in 269 squares. The average indicators for species diversity in the indices are Boraginaceae SR = 2.3, Asteraceae SR = 2.2, Brassicaceae SR = 2.2, Poaceae SR = 2, and Fabaceae SR = 1.8. Average value of the accumulations density: Brassicaceae CD = 3, Asteraceae CD = 2.9, Poaceae CD = 2.7, Boraginaceae CD = 2.6 and Fabaceae CD = 2.3. Among the polymorphic

families, the highest species diversity by index is 13, with BW286 per square foot corresponding to the Boraginaceae family. Subsequent results demonstrated the following: BI277, BI278 SR = 11, Poaceae BY289 SR = 9, Asteraceae CC263, CC264, CD261, CD262, CF266, CH268, CH269, CL273 SR = 7 and Fabaceae BI277, BI278 SR = 7. Results in terms of accumulations density are Boraginaceae BI277 CD = 34, Brassicaceae CD = 32, Poaceae CD = 29, Asteraceae CD = 24 and Fabaceae BI277 CD = 22. Distribution of the polymorphic families by the grid map indices is given in Figures 6-15.

5. Conclusions

The ephemeras of the natural flora of the Fergana Valley of the Republic of Uzbekistan were studied in the smallest territorial floristic unit in the cross section of indices at 5 × 5 km scale unit. 8 317 herbarium data of ephemeras of 214 species that are formed in the natural flora of the Fergana Valley of the Republic of Uzbekistan were collected. They cover 797 indices on the grid map according to their spatial location and take 89% of the research area. The average species diversity of the indices made 8 species; the density of accumulations made 10 herbarium specimens. The maximum species richness score was 63, corresponding

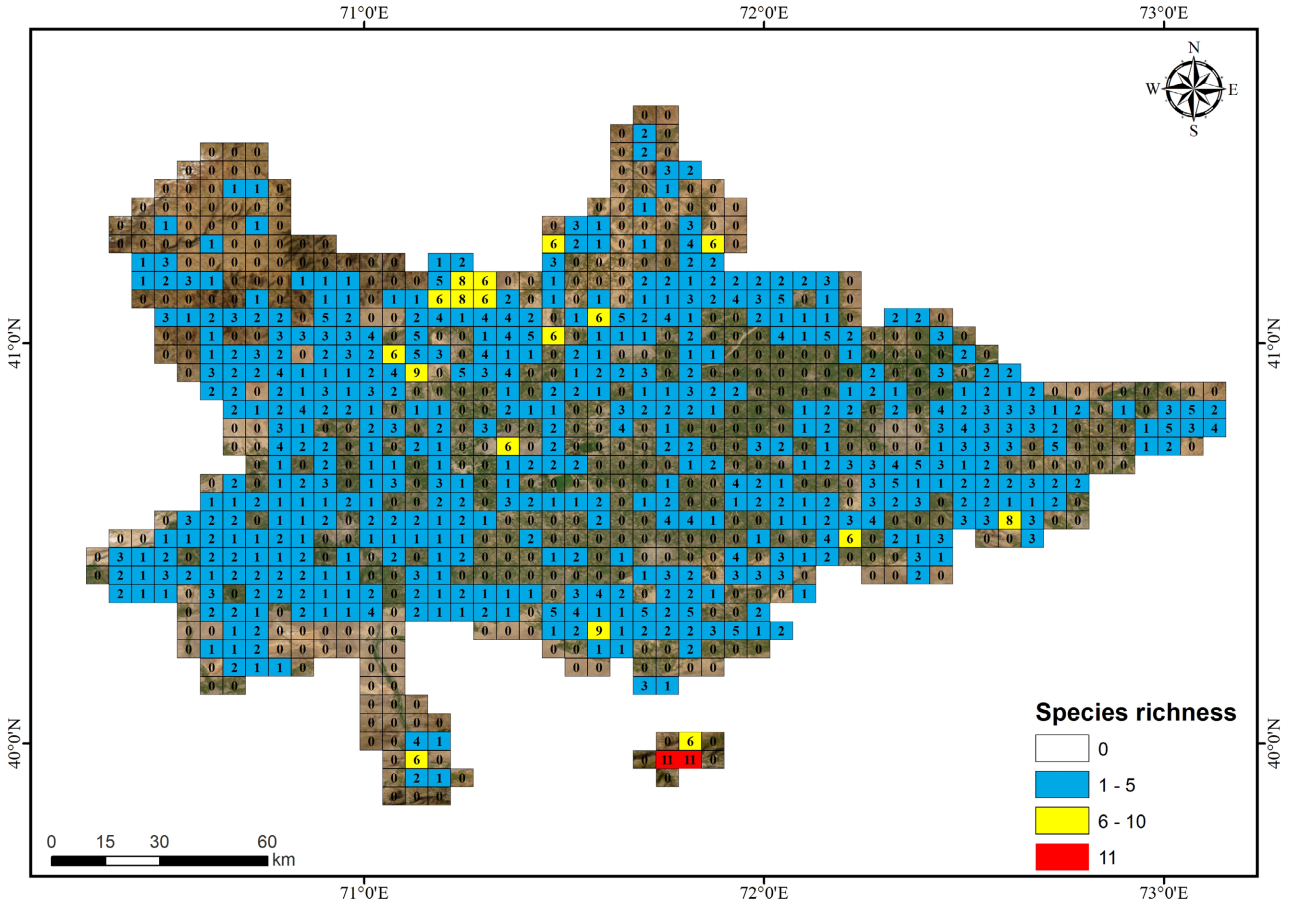

Figure 6. The grid map of species diversity of the Brassicaceae family.

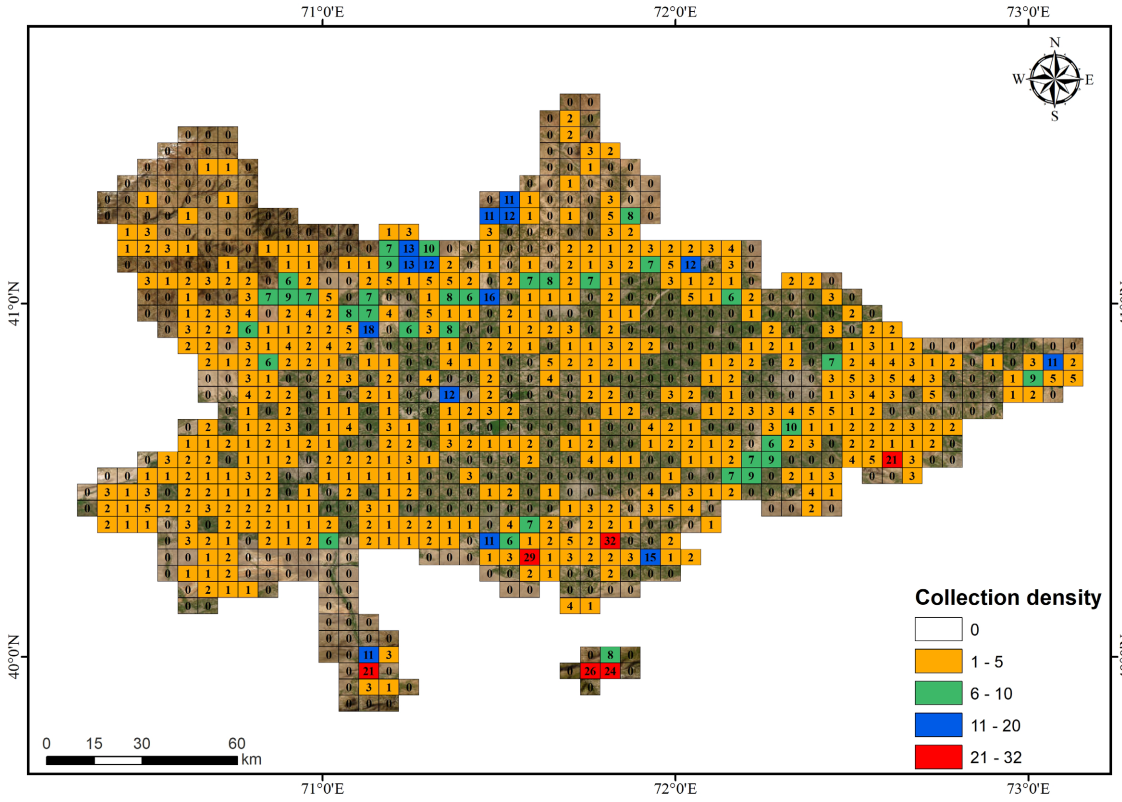

Figure 7. The grid map by the accumulations density of the Brassicaceae family.

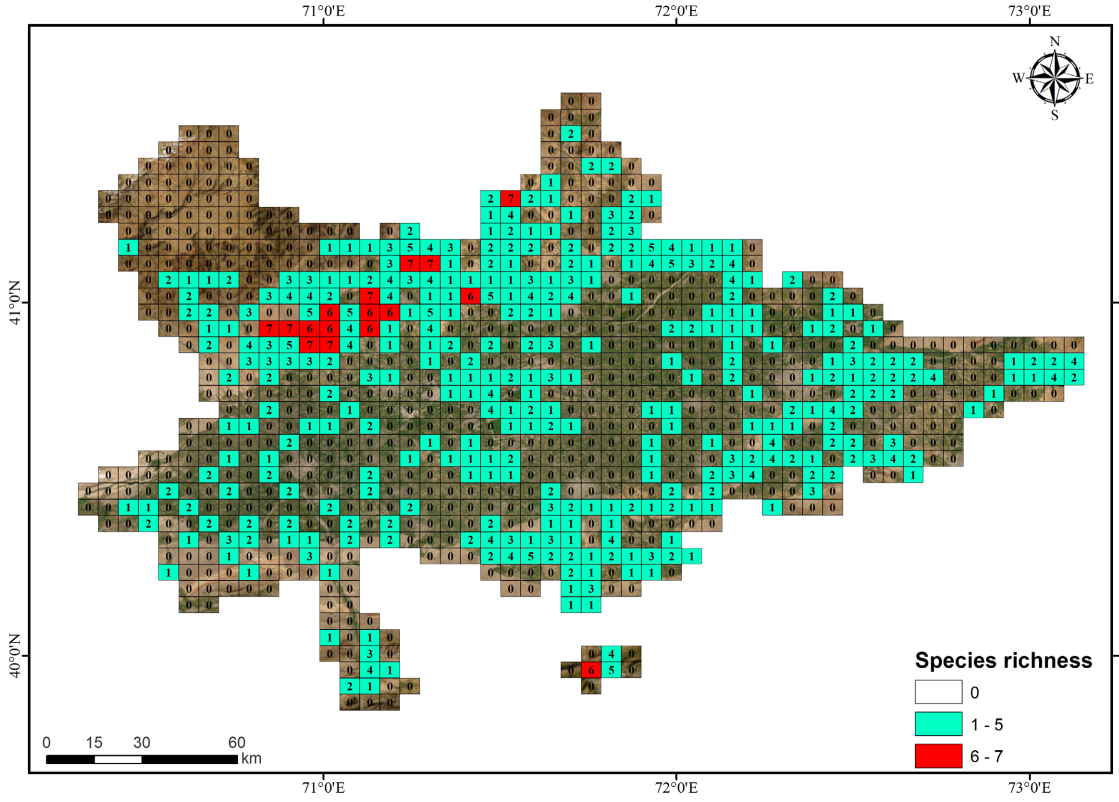

Figure 8. The grid map of the Asteraceae family by species diversity.

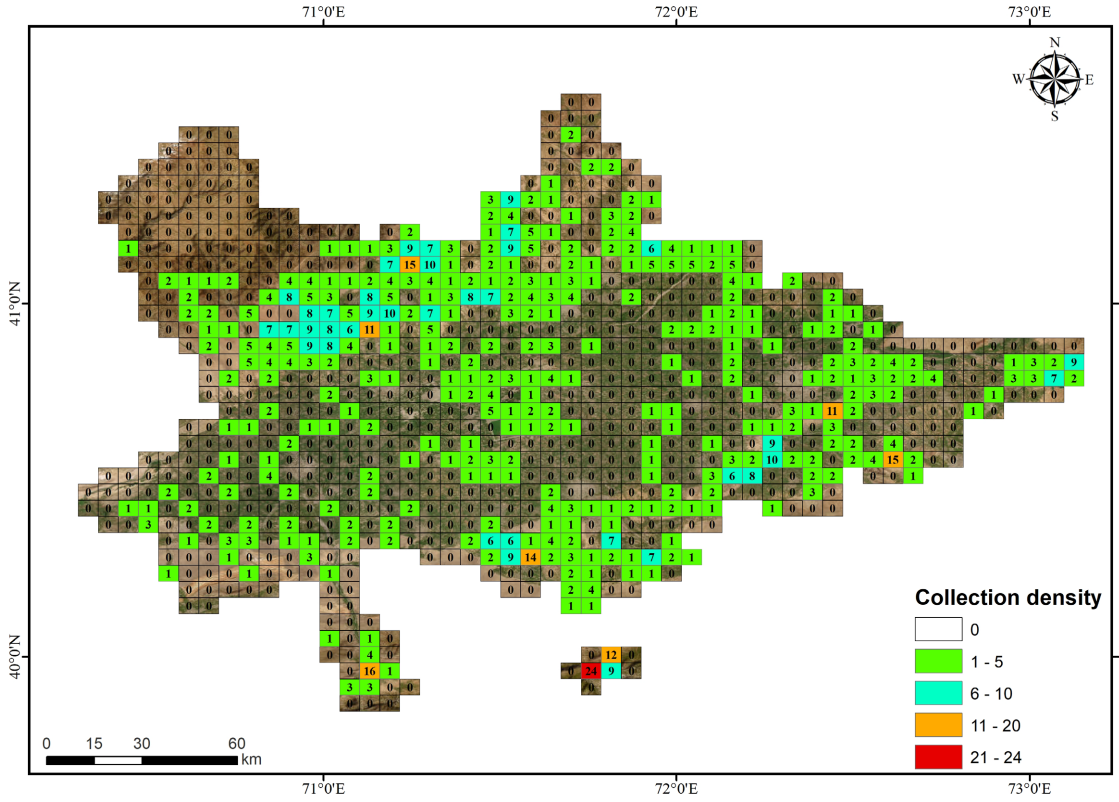

Figure 9. The grid map by the accumulation's density of the Asteraceae family.

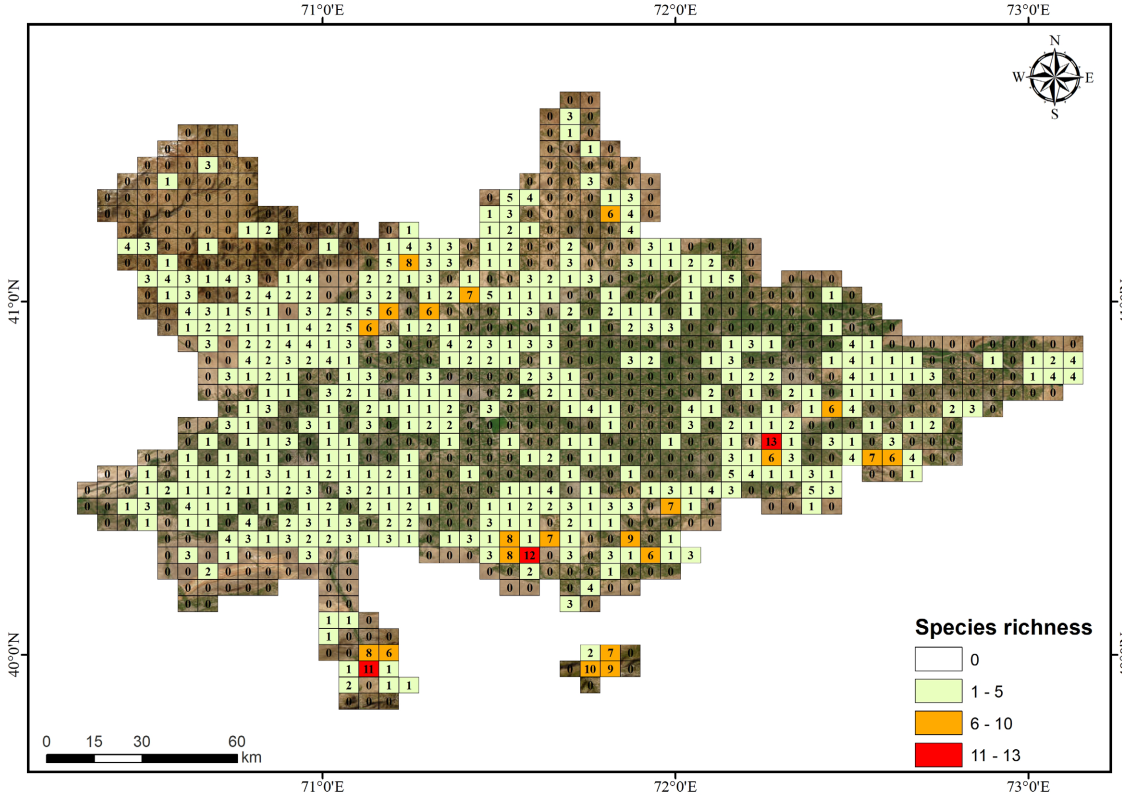

Figure 10. The grid map of species diversity of the Boraginaceae family.

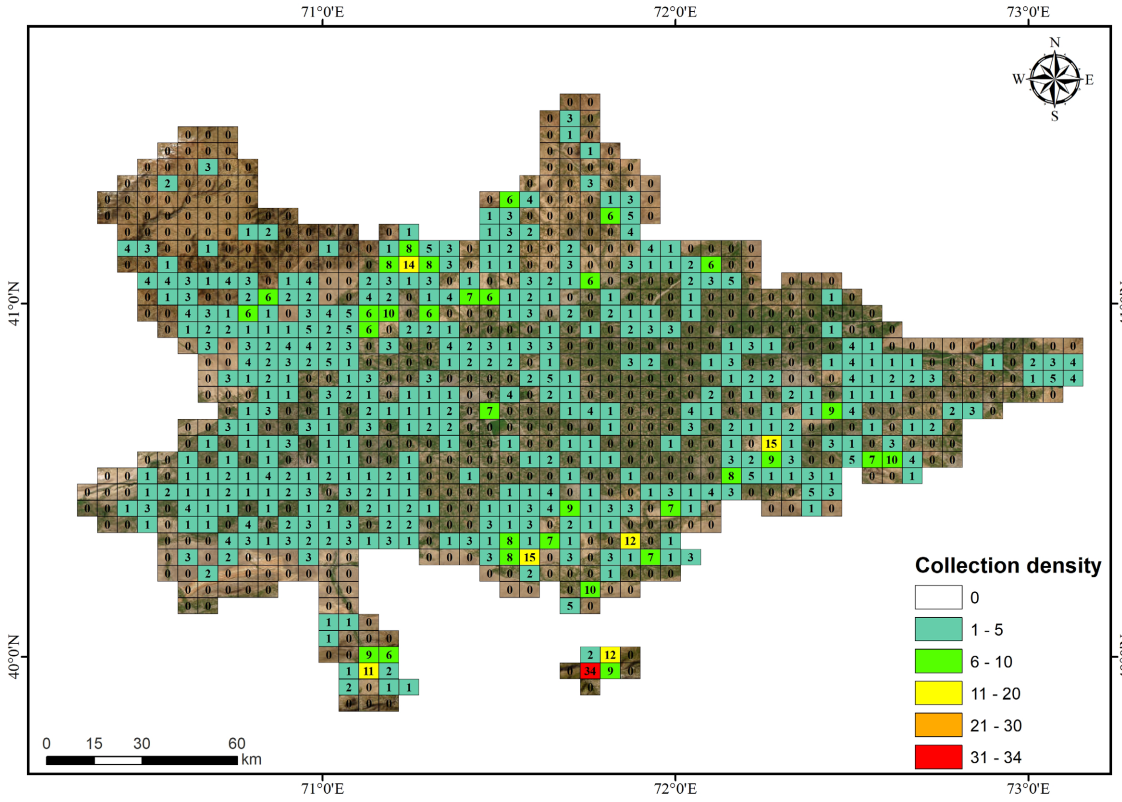

Figure 11. The grid map by the accumulation's density of the Boraginaceae family.

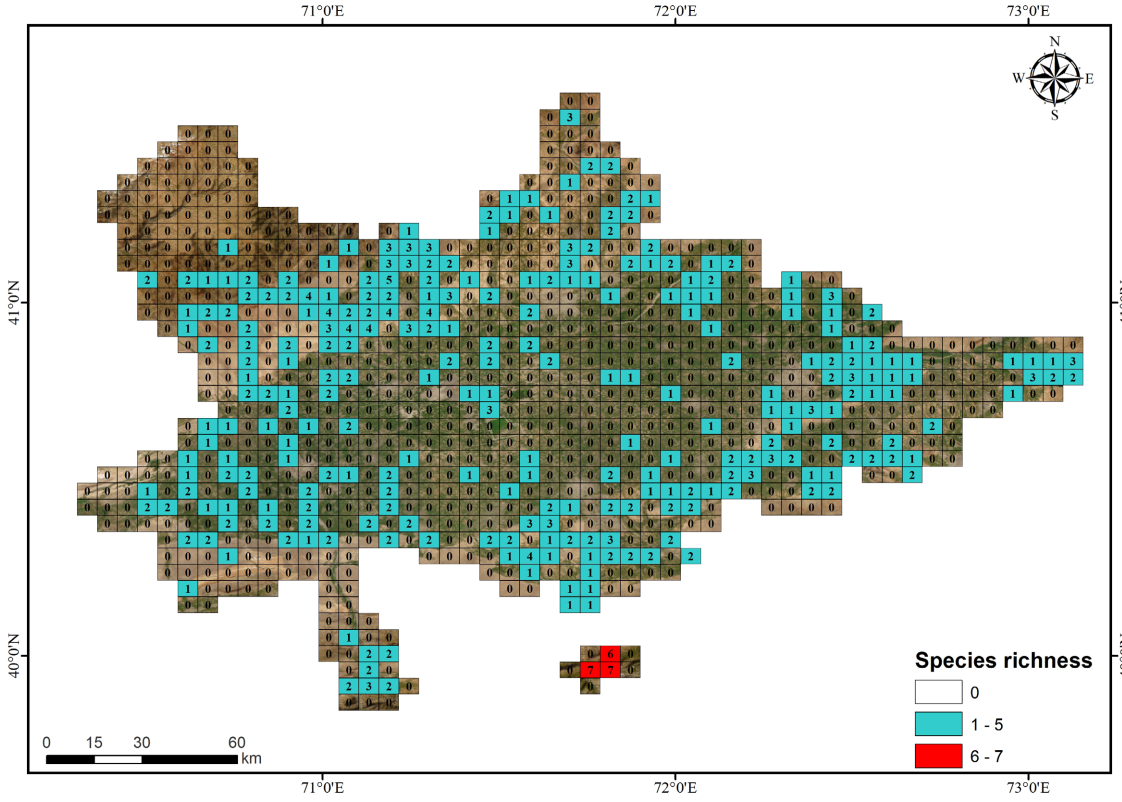

Figure 12. The grid map of species diversity of the Fabaceae family.

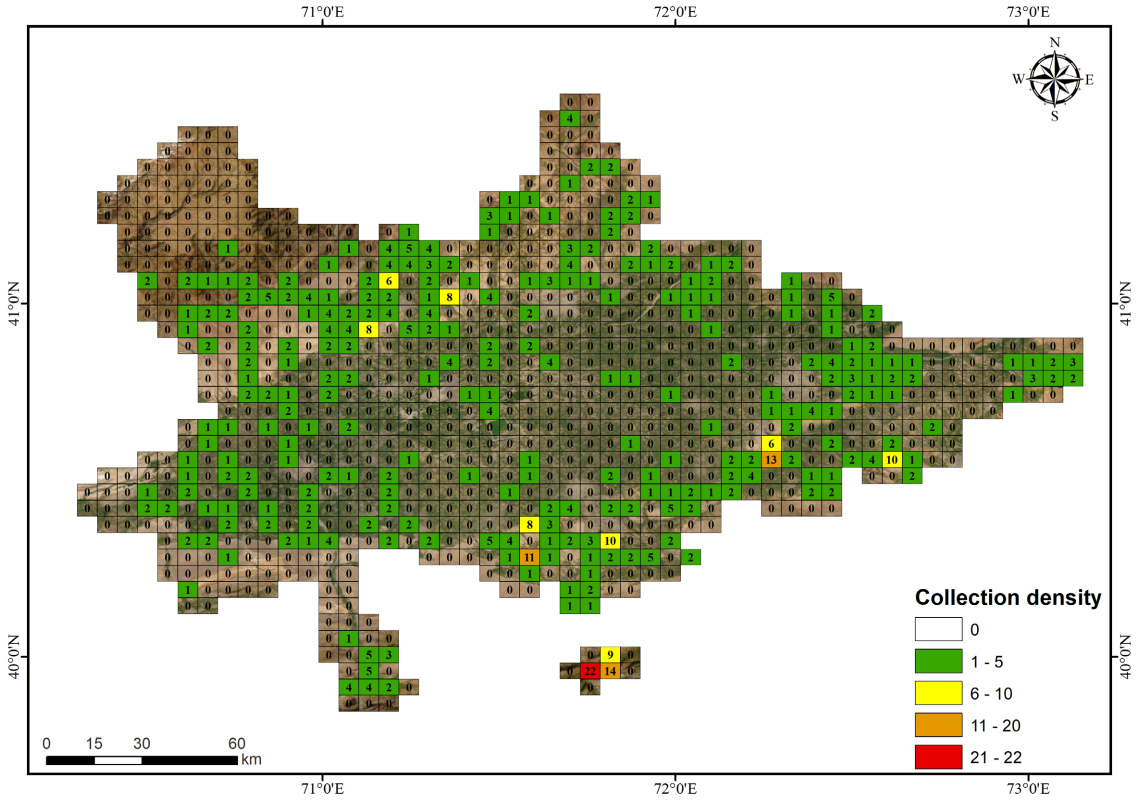

Figure 13. The grid map by the accumulation's density of the Fabaceae family.

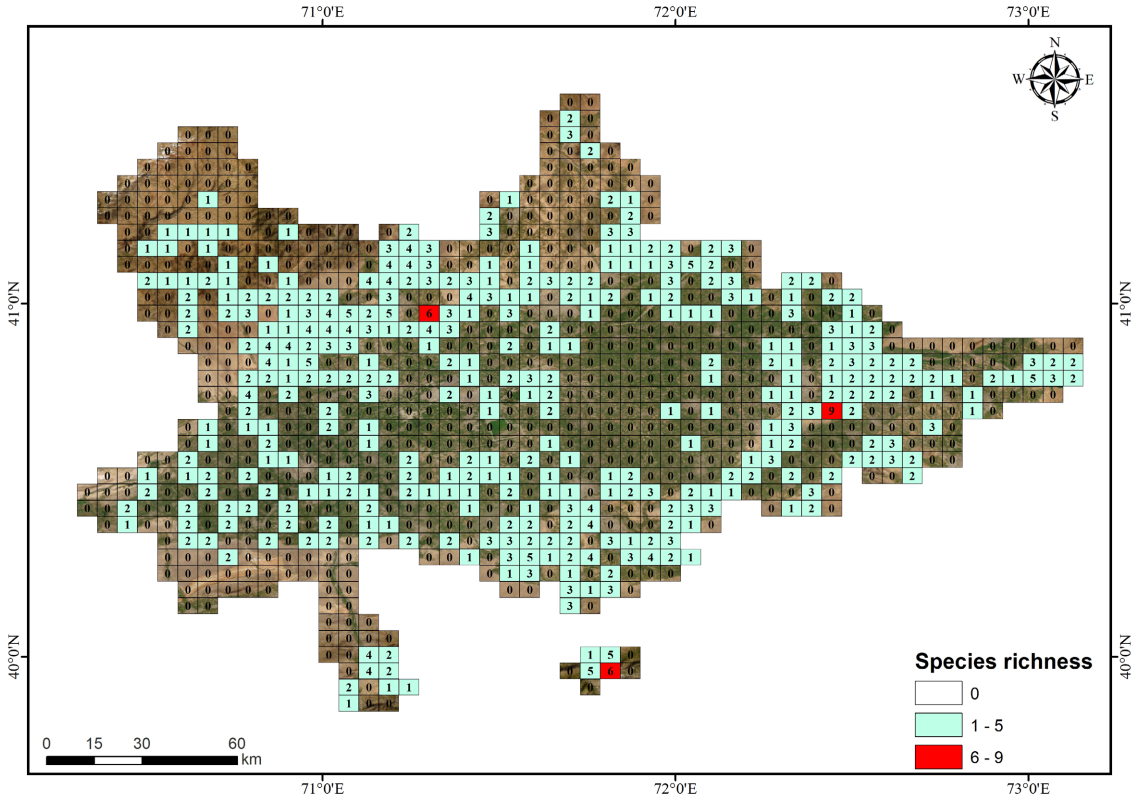

Figure 14. The grid map of species diversity of the Poaceae family.

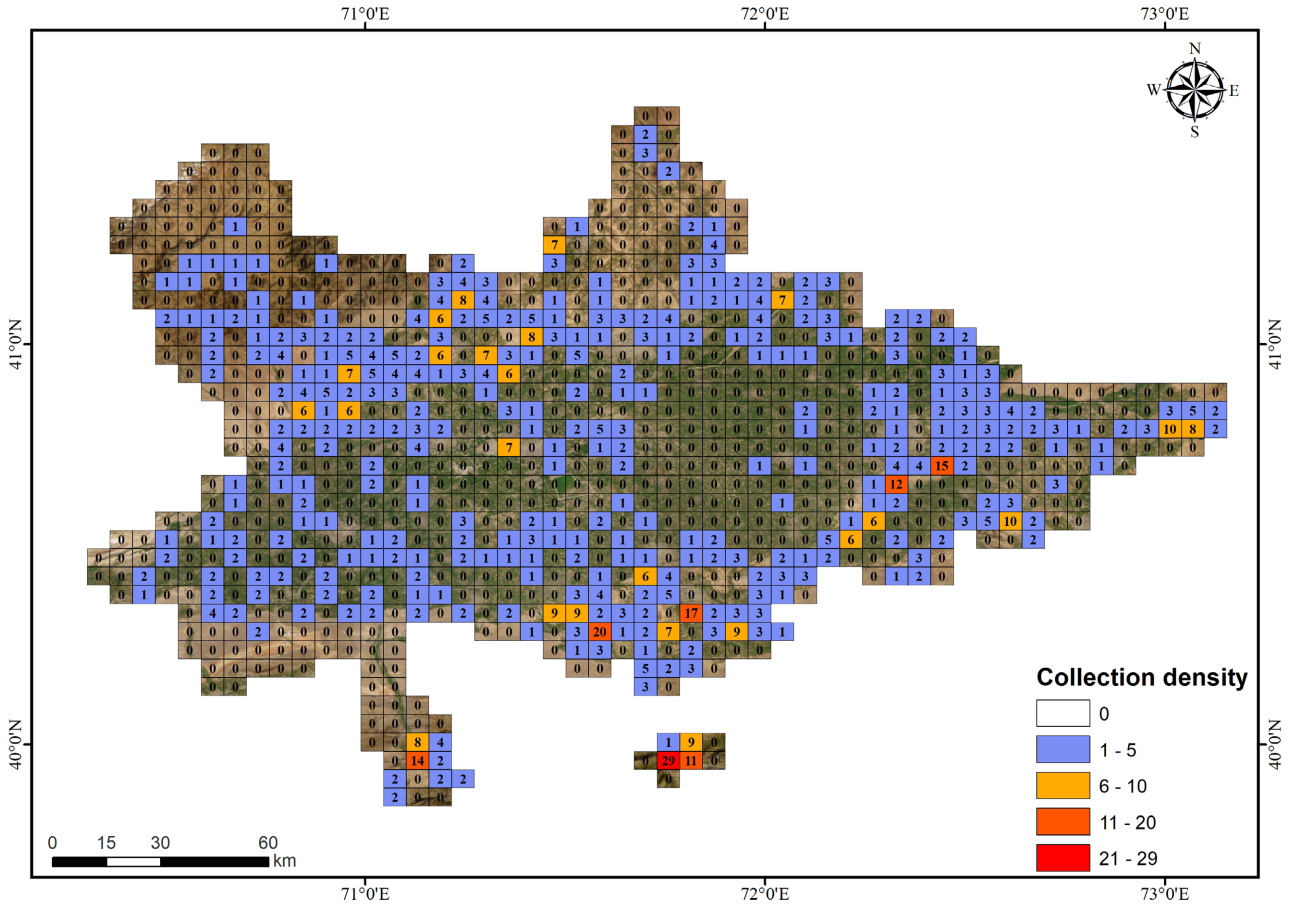

Figure 15. The grid map by the accumulation's density of the Poaceae family.

to the indexes BI277, BI278 (Shohimardon). Also, according to the accumulation's density, the BI277 square leads with 226 herbarium samples.

Among ephemeras, a sequence of polymorphic families is as follows: Brassicaceae, Asteraceae, Boraginaceae, Fabaceae, and Poaceae. This sequence is different from the indicator of Asteraceae, Fabaceae, Poaceae and Brassicaceae, which is characteristic of the Central Asian local floras. The result shows that ephemeras in natural flora have a specific formation tendency, which is separate from general regularities. The leading families accounted for 58% of the total species and 62% of herbarium data.

Acknowledgements

The article was prepared within the framework of the state project on the topic Grid mapping of the flora of mountainous regions of southern Uzbekistan funded by the government of the Republic of Uzbekistan.

Conflicts of Interest

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

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