

HOTSPOT ANALYSIS BASED ON SPECIES RICHNESS IN THE
TRANSBOUNDARY TERRITORIES OF THE WESTERN TIAN SHAN MOUNTAIN
RANGE (GETIS–ORD GI*)

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Abstract: *In this study, the spatial distribution of floristic richness in the transboundary territories of the Western Tian Shan mountain range was assessed based on the Species Richness (SR) metric. Spatial statistical analysis was performed using the Getis–Ord Gi* statistic to identify areas of high and low concentrations of biodiversity. The results revealed a heterogeneous spatial distribution of SR across the study area and identified prominent hotspot zones within the Western Chatkal botanical–geographical region.*

Keywords: *Species Richness (SR); hotspot analysis; Getis–Ord Gi*; spatial distribution; biodiversity patterns; floristic richness; Western Tian Shan; transboundary regions; botanical-geographical region*

INTRODUCTION

The Western Tian Shan mountain range is one of the key floristic centers of Central Asia, characterized by a high level of endemism and ecological diversity. Identifying the spatial patterns of biodiversity in this region, particularly the distribution of species richness (Species Richness, SR), is of significant importance for ecological and biogeographical studies.

Spatial statistical methods, particularly the Getis–Ord Gi* statistic, are effective tools for detecting clustering patterns in floristic data. This approach enables the identification of areas with high and low concentrations of biodiversity (hotspots and coldspots) within the study region.

Materials and Methods

In this study, Species Richness (SR) was calculated based on grid cells measuring 5 × 5 km. The number of species recorded within each grid cell was accepted as the overall indicator of species richness.

To assess the spatial distribution of SR values, the Getis–Ord Gi* statistic was applied (Arthur Getis and J. Keith Ord, 1992). A fixed distance band was used as the distance-based neighborhood matrix, and the SR values of neighboring grid cells were compared with the overall mean value for each grid cell (index).

The results were interpreted based on Z-scores as follows:

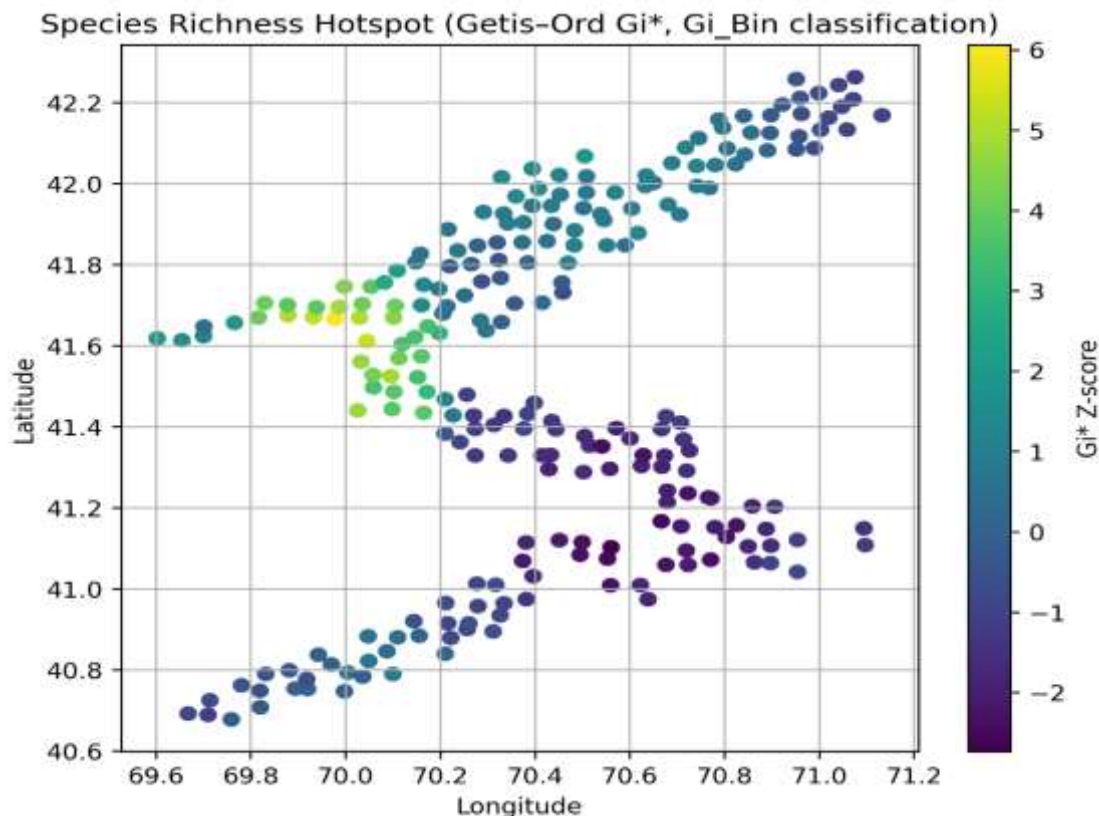
- $Z \geq 1.65$ – 90% confidence level (hotspot)
- $Z \geq 1.96$ – 95% confidence level (hotspot)
- $Z \geq 2.58$ – 99% confidence level (hotspot)

- $Z < 0$ – coldspot

For the classification of results, the G_i _Bin method was applied. This approach is based on the concept of Local Indicators of Spatial Association (LISA) (Luc Anselin, 1995).

Results and Discussion

The hotspot analysis based on Species Richness (SR) revealed a markedly heterogeneous spatial distribution of floristic richness across the study area. According to the results of the Getis–Ord G_i^* analysis, statistically significant hotspot zones were concentrated in specific areas, whereas coldspot zones corresponded to regions with relatively low biodiversity.



The most prominent hotspot zones were identified within the Western Chatkal botanical–geographical region, particularly in the grid cells CQ247, CR247, CS248, CT242, CT245, CU246, and CU247. These areas largely correspond to the Greater and Lesser Chingan massifs and are characterized by high SR values.

The formation of these hotspot zones can be explained by several factors. First, the complex orographic structure of the region and steep altitudinal gradients promote the coexistence of diverse ecological niches within a relatively limited area. Second, the heterogeneity of microclimatic conditions facilitates local species concentration. Third, the region functions as a floristic contact zone, where interactions among different biogeographical elements contribute to increased species diversity.

The spatial distribution of hotspot zones indicates the presence of localized centers of floristic richness and confirms the uneven distribution of biodiversity across the study area.

When integrated with the results of β -diversity analysis, ordination methods such as PCoA and NMDS revealed clear clustering patterns among grid cells based on floristic

composition. In particular, the coincidence of hotspot zones with areas exhibiting high β -turnover allows these sectors to be interpreted as centers of floristic exchange.

Conclusion

The spatial analysis based on Species Richness in the transboundary territories of the Western Tian Shan demonstrated that floristic richness is unevenly distributed and concentrated in specific areas. The Western Chatkal botanical–geographical region was identified as a major floristic hotspot. These results provide an important scientific basis for biodiversity conservation and for the identification of priority areas within the region.

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