

# Assessment of flora diversity in a minor river valley using ecological indicator values, Geographical Information Systems and Digital Elevation Models

## Research Article

Bożenna Czarnecka<sup>1,\*</sup>, Łukasz Chabudziński<sup>2</sup>

<sup>1</sup>Department of Ecology, Faculty of Biology and Biotechnology,  
Maria Curie-Skłodowska University, 20-033 Lublin, Poland

<sup>2</sup>Geoinformation Laboratory,  
Faculty of Earth Sciences and Spatial Management,  
Maria Curie-Skłodowska University, 20-718 Lublin, Poland

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**Abstract:** Ellenberg indicator values (EIV) have been widely used to estimate habitat variables from floristic data and to predict vegetation composition based on habitat properties. Geographical Information Systems (GIS) and Digital Elevation Models (DEM) are valuable tools for studying the relationships between topographic and ecological characters of river systems. A 3-meter resolution DEM was derived for a 3-km-long break section of the Szum River (SE Poland) from a 1:10,000 topographic map. Data on the diversity and ecological requirements of the local vascular flora were obtained while making floristic charts for 32 sections of the river valley (each 200 m long) and physical and chemical soil measurements; next, the data were translated into EIV. The correlations of the primary and secondary topographic attributes of the valley, species richness, and EIV (adapted for the Polish vascular flora) were assessed for all species recognized in each valley section. The total area and proportion of a flat area, mean slope, slope curvature, solar radiation (SRAD), and topographic wetness index (TWI) are the most important factors influencing local flora richness and diversity. The highest correlations were found for three ecological indicators, namely light, soil moisture, and soil organic content. The DEM seems to be useful in determination of correlations between topographic and ecological attributes along a minor river valley.

**Keywords:** Species richness • Species diversity • Vascular plants • River landscape • Edaphic factors • Topographic attributes • Solar radiation • Wetness index

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## 1. Introduction

River systems integrate the structure, dynamics, and function of all components of the landscape [1]. Habitat complexes of river valleys are characterized by considerable heterogeneity defined as variability of spatial and temporal patterns and processes [2]. Environmental heterogeneity of the riparian landscape is a result of river fluvial activity (erosion, transport, sedimentation), organic-matter dynamics, climatic factors, and hydrological relationships between all abiotic and biotic environmental elements [3-10]. The vegetation landscape of the river valley is characterized by specific zonal toposequence of plant communities [6,9,11]. Biodiversity of river systems may be considered at various levels of organization – from the physico-

geographical region to the habitat patch, i.e., from the macro- to nanoscale [3,11-14].

Over the last decades, Geographical Information Systems (GIS) and Digital Elevation Models (DEM) have been widely used to study the relationships between topographic and ecological features of different landscapes, including river systems [15-21]. DEM derivatives related to species occurrence [22] and vegetation diversity [23] are also analyzed. Multivariate canonical analyses are currently in common use for identifying repeatable patterns in species distribution in terms of environmental factors [9,22,24-28].

The aim of this study was: (1) to find correlations between the morphological characters of a small-scale river valley (IV rank river) and ecological elements (local flora and its requirements) occurring in the valley,

\* E-mail: bozenna.czarnecka@poczta.umcs.lublin.pl