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Application of principal component analysis to ecodiversity assessment of postglacial landscape (on the example of Debnica Kaszubska commune, Middle Pomerania)

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In order to assess ecodiversity understood as a comprehensive natural landscape factor (Jedicke 2001), it is necessary to apply research methods which recognize the environment in a holistic way. Principal component analysis may be considered as one of such methods as it allows to distinguish the main factors determining landscape diversity on the one hand, and enables to discover regularities shaping the relationships between various elements of the environment under study on the other hand.
The procedure adopted to assess ecodiversity with the use of principal component analysis involves: a) determining and selecting appropriate factors of the assessed environment qualities (hypsometric, geological, hydrographic, plant, and others); b) calculating the absolute value of individual qualities for the basic areas under analysis (e.g. river length, forest area, altitude differences, etc.); c) principal components analysis and obtaining factor maps (maps of selected components); d) generating a resultant, detailed map and isolating several classes of ecodiversity.
An assessment of ecodiversity with the use of principal component analysis was conducted in the test area of 299,67 km2 in Debnica Kaszubska commune. The whole commune is situated in the Weichselian glaciation area of high hypsometric and morphological diversity as well as high geo- and biodiversity.
The analysis was based on topographical maps of the commune area in scale 1:25000 and maps of forest habitats. Consequently, nine factors reflecting basic environment elements were calculated: maximum height (m), minimum height (m), average height (m), the length of watercourses (km), the area of water reservoirs (m2), total forest area (ha), coniferous forests habitats area (ha), deciduous forest habitats area (ha), alder habitats area (ha). The values for individual factors were analysed for 358 grid cells of 1 km2.
Based on the principal components analysis, four major factors affecting commune ecodiversity were distinguished: hypsometric component (PC1), deciduous forest habitats component (PC2), river valleys and alder habitats component (PC3), and lakes component (PC4). The distinguished factors characterise natural qualities of postglacial area and reflect well the role of the four most important groups of environment components in shaping ecodiversity of the area under study.
The map of ecodiversity of Debnica Kaszubska commune was created on the basis of the first four principal component scores and then five classes of diversity were isolated: very low, low, average, high and very high. As a result of the assessment, five commune regions of very high ecodiversity were separated. These regions are also very attractive for tourists and valuable in terms of their rich nature which include protected areas such as Slupia Valley Landscape Park.
The suggested method of ecodiversity assessment with the use of principal component analysis may constitute an alternative methodological proposition to other research methods used so far.

Literature

Jedicke E., 2001. Biodiversität, Geodiversität, Ökodiversität. Kriterien zur Analyse der Landschaftsstruktur – ein konzeptioneller Diskussionsbeitrag. Naturschutz und Landschaftsplanung, 33(2/3), 59–68.