THE USE OF SPECTRAL INDICES TO ASSESS THE TROPHICITY OF FOREST HABITATS

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Knowledge in the field of habitat science is considered essential in ecological research, climate change studies, and forestry practices. In traditional habitat classification, two systems of habitat condition analysis are encountered: single-factor and multi-factor. Both are labor-intensive and costly. Remote sensing methods provide an objective, faster and more cost-effective alternative. The research aimed to find a connection between spectral indices obtained from satellite images and indices allowing the assessment of the trophic status of forest habitats. The starting point was to assume that:

a) The trophic status of forest ecosystems depends on water availability and the diverse water retention capacity of the terrain, including topography, geological, and soil conditions.
b) The trophism of forest habitats affects the diversity of plant communities.
c) The diversity of plant communities related to habitat trophism is reflected in differences that can be captured by various spectral indices.

Based on these assumptions, the hypothesis was formulated that if the trophic diversity of forest habitats affects the variability in pixel brightness of satellite imagery through vegetation, then differences in the trophic status of forest habitats can be inferred from it.

Using various analytical techniques, including covariance matrix analysis, two dimensionality reduction algorithms (PCA and UMAP), and algorithms such as: (i) Linear Discriminant Analysis (LDA), (ii) Quantitative Descriptive Analysis (QDA), (iii) Logistic Regression, (iv) Support Vector Machine (SVM), (v) Random Forest, it was shown that:

a) Among the 249 considered spectral indices, NDVI (Normalized Difference Vegetation Index) proved to be the best,
b) There is a high correlation between NDVI values and parameters resulting from the trophic status of forest habitats, such as tree height and thickness, as well as between NDVI values and the diversity of plant communities reflecting the natural differentiation of forest habitats,
c) It is possible to build a mathematical model that allows the assessment of the moisture condition of forest habitats based on the NDVI index,
d) NDVI can be used to assess the spatial extent of specific tree species in forested areas.

Keywords: NDVI; humidity; forest typology; habitat requirements of forest trees