



Original Research Paper

Artificial Intelligence Modelling of Vegetation Complexity and Ground Faunal Richness

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Key Words

Abstract

Artificial intelligence, Vegetation complexity, Ground fauna, Biodiversity assessment, Habitat modelling, Ecological prediction.

Vegetation complexity is a key ecological factor affecting habitat structure, resource availability, microclimate, and distribution of ground fauna. Existing biodiversity assessment techniques are mostly based on field observation and conventional ecological observations, which are time-consuming and space-bound and are hard to implement for large landscapes. The use of artificial intelligence (AI) modelling allows studying complex interrelations between vegetation properties and faunal diversity using ecological observations, environmental parameters and spatial data. This paper develops the conceptual framework for using AI modelling in evaluating vegetation complexity and ground faunal richness through identification of ecological patterns related to habitat structure. Materials & Methods: The suggested theoretical framework is based on the integration of vegetation parameters, such as canopy density, vegetation diversity, variability of vegetation heights, coverage percentage and habitat heterogeneity with faunal parameters, such as species richness, abundance distribution and habitat preferences. Artificial intelligence modelling methods, including machine learning and deep learning techniques, are used for analysis of multi-dimensional ecological relations and ground faunal richness predictions. Information on remote sensing, field studies, and environmental parameters were viewed as the possible inputs in the development of predictive models that could be used for habitat evaluation. Results: From the theoretical analysis it follows that the use of AI technology in the ecological modelling makes it possible to detect rather complicated patterns of interaction between vegetation structure and the distribution of fauna. The heterogeneity of vegetation, availability of shelters, and habitats were regarded as the important factors affecting the distribution and richness of fauna. Prediction methods based on machine learning can help to better understand the relationship between habitat and species taking into account several ecological variables at once. The suggested approach demonstrates the importance of the use of AI models for the biodiversity evaluation, detection of ecologically important habitats, and provision of predictive data. AI methods of analysis can help to avoid limitations in the traditional biodiversity surveys and make it possible to carry out repeatable and data-supported ecological evaluation on a large scale. Conclusion: Artificial Intelligence Modelling of Vegetation Complexity and Ground Faunal Richness.

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Introduction

The complexity of vegetation is important in terms of maintaining ecosystem stability through its effects on habitat structure, resource provision, microclimate, and species interactions. The structural complexity of the vegetation, which involves vegetation composition, plant diversity, and habitat complexity, contributes greatly to the provision of shelter and other resources to ground-dwelling species. The evaluation of vegetation is critical in understanding biodiversity patterns as well as formulating conservation measures. Traditional ecological surveys tend to be resource intensive and might not cover a broad geographical space in terms of their spatial coverage. There have been studies that indicate the potential of ensemble models in predicting foliage cover and species richness (McNellie et al., 2021).

Advancements in the field of AI have provided a new opportunity for understanding complex ecological interactions using data models. Using AI systems, one is able to combine various environmental parameters along with biological observation and remote sensing data in order to understand any underlying patterns. Using AI in creating ecological models and designing habitats indicates the role of AI in analyzing natural forms and ecosystems (Mirra et al., 2022). Likewise, smart vegetation monitoring systems utilizing IoT-sensor-based methods have enhanced the ability to continually monitor the state of vegetation and changes in the environment (Hemasundari et al., 2025).

AI-driven biodiversity modeling offers a chance for integrating classical ecological

understanding with advanced computation for better conservation planning (Ullah et al., 2025). In addition, AI in the modeling of forest ecosystems has the potential to analyze complicated biophysical relationships at the ecosystem level (Lemenkova, 2026). Nevertheless, the application of AI in connecting vegetation complexity to ground faunal richness is relatively new research that requires an ecologically sound framework. Hence, this research will theoretically examine AI-modelling techniques that are used in studying vegetation complexity in order to predict ground faunal richness.

Literature Survey

Application of artificial intelligence (AI) to the study of ecology has increased the knowledge of the interactions between various ecological factors, features of vegetation, and biodiversity patterns. Ecological investigations conducted earlier usually relied on field measurements, which could encounter difficulties in analysing the large-scale variations in habitats. However, new research has shown that machine learning can help determine the connections between species and habitats by using different ecological factors. Frameworks based on artificial intelligence have demonstrated the ability to uncover the preferences of different species through analyzing environmental conditions and landscape features (Ennakri et al., 2025).

The ground fauna survey also constitutes a part of ecosystem monitoring since there is great involvement of soil organisms in the process of nutrient cycling and decomposition in addition to being an active part of habitats. Identification of

soil arthropods by conventional means is usually laborious and requires expertise. The combination of AI with morphological and molecular methods of soil arthropod identification has resulted in increased precision and speed of identification with the result of better biodiversity assessment (Remelli et al., 2026).

Diversity in plants is highly affected by disturbances and human activities in the environment. Predictive models using artificial intelligence technology have been used to assess the effect of human activities on vegetation diversity within the protected rangelands. This is through providing insights into the significant ecological drivers that can be used for ecosystem restoration (Jahani et al., 2024). In the same way, machine learning and deep learning techniques have been used for biodiversity prediction in consideration of environmental drivers (Chang, 2023).

The recent advances have taken the application of artificial intelligence techniques in ecological modelling even further in terms of seasonal and spatial variations among the ground-dwelling animals. Machine learning techniques have been applied to forecast the changes in the dynamics of epigeic animals by taking into account landscape features and environmental conditions. The necessity of applying computational techniques in ecology is evident from the above example (Langraf & Petrovičová, 2025). Although the existing literature proves the applicability of AI technologies in predicting biodiversity, not enough research has been conducted in relation

to the joint modelling of vegetation complexity and ground fauna richness.

AI-Based Ecological Modelling Framework

In this research, we aim at developing a theoretical ecological modeling framework using the Artificial Intelligence technique to investigate the connection between the complexity of the vegetation and the richness of ground fauna. Ecological modeling includes vegetation, environment and faunal diversity indices to provide us with an insight into the ecological quality of the habitat. The vegetative factors such as plant structure diversity, foliage coverage, canopy diversity, vegetation density, and habitat heterogeneity have been taken as the input factors indicating the complexity of the ecosystem.

The framework under consideration entails four phases, namely ecological data acquisition, feature representation, machine learning, and prediction of biodiversity. The environmental and vegetation variables undergo pre-processing and normalization to generate the relevant ecological features. The idea is to use machine learning and deep learning methods in order to find associations between vegetation structures and animal distributions. The model uses complicated interactions between many ecological parameters to assess variability in the richness of ground fauna. The results of the analysis could help evaluate the habitat by pointing out features of the vegetation that lead to increased biodiversity. The theory demonstrates the usefulness of the application of artificial intelligence models in ecology as a

decision-support tool. Future applications will involve remote sensing technology, field studies, and real-time environmental monitoring.

Results and Discussion

The suggested AI-assisted framework for ecological modeling provides evidence of the applicability of artificial intelligence approaches

in analyzing the vegetation-fauna correlation. The theoretical analysis proves that vegetation heterogeneity contributes to an increase in faunal diversity due to favorable living conditions provided by more shelter, better access to food resources, and microhabitats. The level of biodiversity changes positively in relation to the development of the vegetative structure.

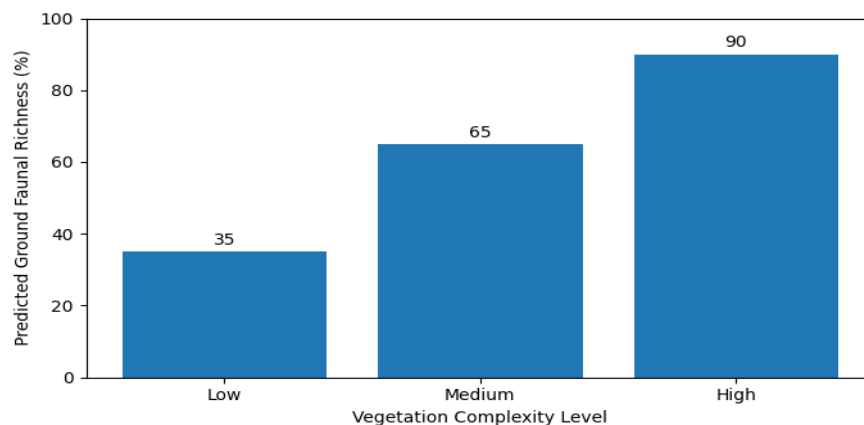


Figure 1. Relationship Between Vegetation Complexity and Ground Faunal Richness

Figure 1 shows the connection between levels of vegetation complexity and ground fauna richness. According to the graph, low complexity in vegetation results in low richness of fauna because of the lack of available resources in the habitat. Medium and high levels of complexity lead to higher numbers of species. The method of modelling used in this paper allows taking into account many ecological factors, among which is vegetation structure.

The results indicate that the ecological models built using machine learning can help researchers and conservation practitioners to assess habitat suitability and predict biodiversity patterns. Unlike conventional methods where the ecological variables are assessed individually, AI-based models consider the complex nonlinear relationships between environmental parameters.

Hence, AI-based vegetation-fauna modeling can act as a decision support method for ecosystem management and biodiversity conservation.

Conclusion

This research proposes a novel AI-driven theoretical model for the simulation of plant complexity and ground fauna diversity. The model demonstrates the power of AI in discovering correlations between habitats and biodiversity. AI-driven models may prove useful in conservation efforts by providing predictive monitoring of biodiversity and sustainable management of ecosystems.

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