Ukrainian Journal of Ecology

Ukrainian Journal of Ecology, 2025, 15(6), 12-14, doi: 10.15421/2025_643

Commentary

Integrating biodiversity conservation, microbial resilience and habitat prioritization in human-impacted landscapes

Natalia Marmiroli*

Department of Plant Biology, University of Milan, Italy

**Corresponding author E-mail: n.marmiroli@unomi.it*

Received: *01 November, 2025, Manuscript No: UJE-26-178653,* ***Editor assigned:*** *03 November, 2025, PreQC No: P-178653,* ***Reviewed:*** *15 November, 2025, QC No: Q-178653,* ***Revised:*** *21 November, 2025, Manuscript No: R-178653,* ***Published:*** *27 November, 2025*

Human activities such as urbanization, agriculture, mining and infrastructure development have profoundly altered natural landscapes, challenging the conservation of biodiversity and ecosystem functions. Microbial communities, as foundational drivers of soil fertility, nutrient cycling and plant resilience, play a pivotal yet often overlooked role in maintaining ecosystem stability under anthropogenic pressure. Concurrently, prioritizing habitats based on ecological, hydrological and social metrics provides a strategic framework for effective conservation interventions. This review synthesizes recent evidence on the interactions among biodiversity conservation, microbial resilience and habitat prioritization in human-impacted landscapes. We discuss how integrating microbial ecology with species-level conservation and spatial habitat assessments can enhance ecosystem resilience, maintain essential services and inform sustainable landscape management. The review highlights multiscale approaches, from microbial to landscape levels, emphasizing the need for interdisciplinary strategies that combine ecological monitoring, social engagement and adaptive management in landscapes facing increasing environmental pressures.

Keywords: Biodiversity conservation, Microbial resilience, Habitat prioritization, Human-impacted landscapes, Ecosystem services, Adaptive management.

Introduction

Human-modified landscapes now constitute the majority of terrestrial ecosystems globally, resulting in habitat fragmentation, pollution and alterations in nutrient cycles. These pressures pose significant threats to biodiversity and the ecosystem services upon which human societies depend. Traditional conservation strategies have largely focused on species-level protection and the establishment of protected areas, yet the underlying microbial and soil processes that support ecosystem productivity and resilience are often neglected. Soil microbial communities regulate critical processes such as carbon sequestration, nitrogen cycling and plant health, influencing both primary productivity and long-term ecosystem stability. Integrating microbial dynamics into conservation planning, alongside habitat prioritization, offers an opportunity to maximize ecological outcomes. Habitat prioritization involves assessing spatial areas based on ecological value, connectivity and the potential to sustain biodiversity, particularly in landscapes influenced by agriculture, urbanization, or extractive industries (Torres A, et al. 2016). Furthermore, considering social-ecological dimensions—such as local livelihoods, community participation and policy frameworks—is crucial to implementing effective conservation strategies. This explores current understanding of microbial resilience, biodiversity conservation and habitat prioritization, highlighting integrated approaches for managing human-impacted landscapes. By examining evidence across scales—from microbial communities to landscape-level habitat networks—we aim to provide insights for sustainable ecosystem management under increasing environmental pressures

Description

Biodiversity underpins ecosystem functioning, offering resilience against environmental perturbations such as climate change, invasive species and land-use alterations. In human-dominated landscapes, species face habitat loss, fragmentation and altered trophic interactions. Studies have shown that conservation interventions, including protected area networks, restoration projects and sustainable land management, can mitigate these impacts and enhance species survival. Active restoration efforts, such as reforestation, wetland rehabilitation and pollinator-friendly agricultural practices, have demonstrated success in improving species richness and ecosystem service provision (Fashola MO, et al. 2016). For example, insect pollinator communities in restored quarries and agricultural lands show partial convergence to natural reference ecosystems, supporting plant reproduction and biodiversity recovery. Integrating biodiversity data into landscape planning allows identification of high-priority areas that maximize conservation outcomes, considering species distribution, connectivity and vulnerability.

Microbial communities are foundational to soil health and ecosystem resilience. They regulate nutrient cycling, mediate plant-soil feedbacks and influence greenhouse gas emissions. Resilient microbial communities can buffer ecosystems against environmental stressors such as drought, pollution and land-use intensification (Chen SL, et al. 2016). Evidence indicates that pre-exposure of soil microbiomes to stress (e.g., drought) can enhance their resistance to subsequent perturbations, stabilizing ecosystem function. The composition and function of microbial communities are shaped by vegetation, soil type and land-use history. Mycorrhizal networks, for instance, improve plant nutrient acquisition and water-use efficiency, enhancing vegetation resilience under environmental stress. Similarly, bacterial communities in semi-arid and wetland soils contribute disproportionately to carbon cycling and greenhouse gas dynamics, influencing both local and global biogeochemical processes (Hunt TN, et al. 2020). Recognizing microbial contributions is critical for designing restoration strategies that reinforce ecosystem function and support biodiversity under anthropogenic pressure.

Habitat prioritization combines ecological, hydrological and social criteria to identify areas of high conservation value. GIS-based modeling, remote sensing and ecological indices are commonly employed to evaluate habitat suitability, connectivity and ecosystem service potential. Prioritization enables resource-efficient conservation, directing efforts toward landscapes that provide maximum ecological benefits and resilience. For example, mapping pollinator habitat suitability across agricultural regions informs restoration and management interventions to maintain pollination services, critical for both wild plant diversity and crop production. Similarly, assessing flood control capability in river basins or the carbon sequestration potential of restored ecosystems allows prioritization of areas that optimize both biodiversity and ecosystem service outcomes (Menkis A, et al. 2014). Integrating microbial and plant functional traits into these models further strengthens conservation strategies by accounting for belowground ecosystem dynamics. Social-ecological considerations further enhance effectiveness. Engaging local communities in participatory mapping, organic farming adoption and resource monitoring aligns conservation goals with human well-being. Studies indicate that co-designed interventions improve compliance, knowledge transfer and sustainable management outcomes. Adaptive management, informed by monitoring microbial and biodiversity indicators, allows iterative refinement of strategies under changing environmental conditions.

Conclusion

Human-impacted landscapes present significant challenges for biodiversity conservation and ecosystem management. Integrating microbial ecology, habitat prioritization and biodiversity-focused interventions offers a robust framework for sustaining ecosystem services and resilience under anthropogenic pressures. Microbial communities mediate soil fertility, carbon cycling and plant resilience, while spatial prioritization ensures efficient allocation of conservation resources. Incorporating social-ecological dimensions, including local community engagement, adaptive management and policy support, further enhances sustainability outcomes. Future landscape management strategies should adopt multiscale, interdisciplinary approaches that bridge microbial, species and landscape levels. By aligning microbial function with habitat prioritization and biodiversity conservation, we can maintain ecosystem services, improve resilience to environmental stressors and foster sustainable human-nature interactions in an era of global change.

Acknowledgement

None.

Conflict of Interest

The authors declare no conflict of interest.

References

Torres, A., Jaeger, J. A., Alonso, J. C. (2016). Assessing large-scale wildlife responses to human infrastructure development. Proceedings of the National Academy of Sciences 113: 8472-8477.

Fashola, M. O., Ngole-Jeme, V. M., Babalola, O. O. (2016). Heavy metal pollution from gold mines: Environmental effects and bacterial strategies for resistance. International Journal of Environmental Research and Public Health, 13: 1047.

Chen, S. L., Yu, H., Luo, H. M., Wu, Q., Li, C. F., Steinmetz, A. (2016). Conservation and sustainable use of medicinal plants: Problems, progress and prospects. Chinese Medicine 11: 37.

Hunt, T. N., Allen, S. J., Bejder, L., Parra, G. J. (2020). Identifying priority habitat for conservation and management of Australian humpback dolphins within a marine protected area. Scientific Reports 10: 14366.

Menkis, A., Ihrmark, K., Stenlid, J., Vasaitis, R. (2014). Root-associated fungi of *Rosa rugosa* grown on the frontal dunes of the Baltic Sea coast in Lithuania. Microbial Ecology 67:769-774.

Citation:

Marmiroli, N., (2025). Integrating biodiversity conservation, microbial resilience and habitat prioritization in human-impacted landscapes. *Ukrainian Journal of Ecology.* 15: 12-14.