



Original Research Paper

Rewilding Degraded Grasslands and its Impacts on Large Herbivore Diversity, Foraging Behaviour and Ecosystem Function

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Key Words	Abstract
Rewilding, Grassland degradation, Large herbivores, Biodiversity, foraging Behavior, Ecosystem function, Restoration ecology.	The effects of rewilding degraded grasslands on the feeding behaviors of large herbivores and ecosystem functions. The world's grasslands are at risk due to factors like overgrazing, land-use change, and habitat fragmentation, causing the decline of biodiversity as well as the loss of ecosystem functions. To tackle this problem, rewilding has emerged as one effective strategy in conservation practice where native species and ecological processes are restored. In this study, we attempt to examine the effect of rewilding degraded grasslands on the diversity of large vertebrates, feeding patterns, and ecosystem functioning. Field sites that have been restored by rewilding techniques and non-rewilded control plots were surveyed using methods like camera trapping, GPS tracking, and line transect sampling to estimate herbivores and their behaviors. Changes in ecosystem function were determined based on vegetation surveys, soil nutrient analysis, and primary productivity levels. Our findings revealed that rewilded plots showed greater species richness of herbivores (7.6 ± 1.2) and greater Shannon-Wiener index of diversity ($H' = 2.48$) compared to control plots (4.2 ± 0.9 ; $H' = 1.75$). The foraging range was seen to be larger, while the use of vegetation patches with higher quality was higher among the herbivores, thus resulting in vegetation heterogeneity and good habitat utilization. Ecosystem functioning improved in rewilded areas, with an increase in above-ground biomass (by 25%), soil nitrogen (by 22%), soil organic carbon (by 18%), and the rate of litter decomposition (by 15%). Large herbivores have been positively correlated with ecosystem metrics ($r = 0.72-0.81$, $p < 0.05$). Thus, they are essential components that contribute to functional restoration. It is confirmed by the results of this experiment that rewilding is an effective measure to restore degraded grasslands. Further studies should include long-term monitoring, effects of climatic variations, and socio-ecological integration

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Introduction

Worldwide grasslands are one of the most endangered ecosystems, which are being degraded due to overgrazing, land use change, and habitat fragmentation. This degradation can have adverse effects on ecological processes, biodiversity, and ecosystem services such as nutrient cycling and primary productivity. Rewilding, whereby native species are reintroduced and/or natural processes restored, is a potential strategy to mitigate these effects and increase the resilience of ecosystems (Bakker & Svenning, 2018; Cromsigt et al., 2018; Sandom et al., 2020).

Large herbivores play an important role in the formation of grasslands, nutrient dispersal, and habitat variability (Kristensen et al., 2022). Large herbivores feed on plants; therefore, their presence plays a role in shaping the vegetation assemblage and provides sustenance for several invertebrates.

Herbivore ecology, behavior, and diversity should be taken into account when devising an effective rewilding intervention (Atkinson et al., 2024; Jepson, 2025).

This study shall examine the impacts of rewilding degraded grassland upon herbivore abundance, herbivory behavior, and ecosystem function. The research will address the following questions:

- What impact does rewilding have on the richness and abundance of herbivores?
- How is the feeding strategy of herbivores altered by rewilding?
- What are the changes in the function of the ecosystem because of these changes?

The research considers these variables and gives evidence-based suggestions to conserve the biodiversity and restore the grassland ecosystems, as well as their management.

Materials and Methods

The research was conducted in degraded grasslands based on the previous land use, the magnitude of grassland degradation, and the accessibility to the site. There was variability in the size, plant species composition, and anthropogenic disturbances of the sites selected for research. There was the establishment of an initial environmental setting of habitat features like soil type, vegetation, and canopy cover.

Monitoring of large herbivore presence was done using camera traps, line transects, and GPS collars. Camera traps were established at important sites such as watering holes and along animal paths to document their presence and activity levels. The population, group sizes, and species diversity were determined using transect surveys carried out seasonally. GPS collaring was used to measure fine-scale movements and foraging patterns.

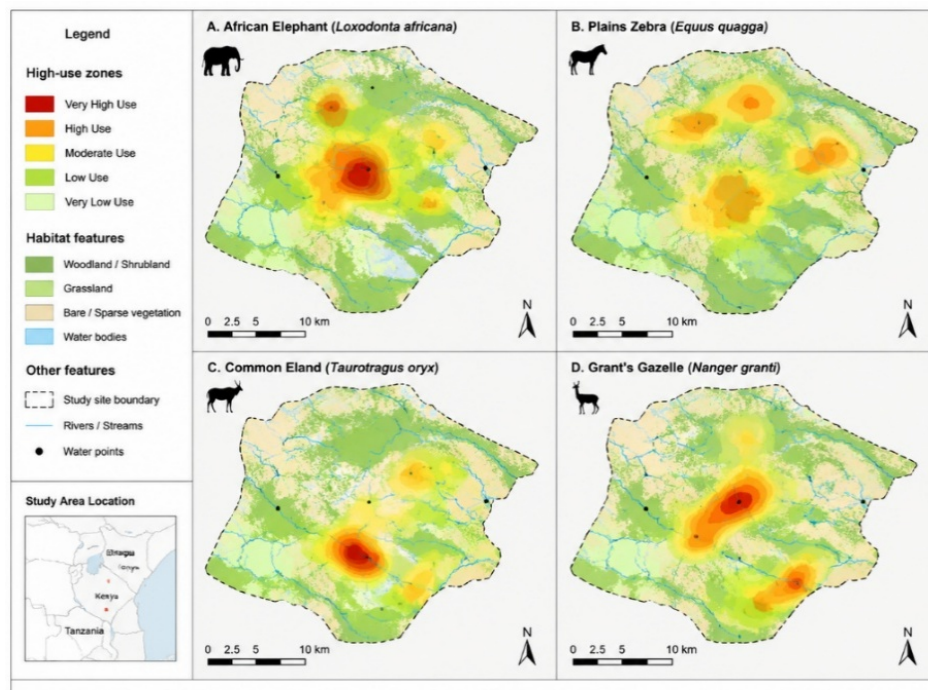


Figure 1: Spatial Distribution of GPS-Tracked Large Herbivores Highlighting High-Use Zones

Figure 1 above shows heat maps of the movement of herbivores that have been tracked using GPS in relation to rewilding and control grasslands. Higher usage of the area is marked using warmer colors; hence, it indicates "hotspots" of usage and preference for habitats by different species. This information will be useful in analyzing the effects of rewilding on animal behavior and their habitats.

The plant species composition, coverage, and biomass were determined through quadrats. Some of the indicators used for evaluating ecosystem function within the ecosystem included soil nutrient content analysis (N, P, OC), primary productivity (aboveground biomass), and decomposition rates of the litter.

Tests for ANOVA and GLM were performed in order to determine the differences in the numbers of herbivores, diversity indexes (Shannon-Wiener and Simpson's), and ecosystem

properties between the rewilding and control sites. Resource selection functions and spatial analysis of movements were used to predict the foraging patterns of herbivores. The impact of the implemented rewilding strategy was determined by analyzing the relationships between herbivore behavior, plants, and ecosystem functionality.

Results

There was a significant change observed in the number and diversity of the large herbivore population in the rewilding grasslands compared to the non-rewilding grasslands. The number of species in the rewilding plots averaged at 7.6 ± 1.2 , whereas there were 4.2 ± 0.9 species in the control plots (Shannon-Wiener index = 2.48 vs 1.75; $p < 0.01$). There was increased animal activity with greater temporal and spatial variation in the rewilding plots. The animals that were not used on any other patches were using GPS technology.

Table 1: Herbivore Species Richness and Diversity Indices Across Rewilded and Control Sites

Site Type	Species Richness (Mean $\pm$ SD)	Shannon-Wiener Index (H')	Simpson's Diversity Index (D)	Evenness (J)
Control	4.2 $\pm$ 0.9	1.75	0.61	0.58
Rewilded	7.6 $\pm$ 1.2	2.48	0.82	0.76

The summary of table 1 is the impact of rewilding on the large herbivore community. There was greater species richness, diversity, and evenness in the rewilded grassland compared to the controls. This indicated that there was effective restoration of the diversity of the herbivores.

Analysis of the feeding behavior of the animals showed that there were more grazing zones and selective grazing towards high-nutrient plants. It was noted that the animals spent 38% more time on plants that were high in nutrient content. This allowed for differential grazing and enabled the regrowth of the plant species. Movement pattern analysis showed overlap of herbivore movement zones and improvements in the vegetation.

Proportionally, indicators of functional ecosystems have improved. Nutrient content in the soil has increased with 22% higher nitrogen and 18% higher organic carbon in rewilded areas compared to controls. In terms of above-ground biomass analysis, primary productivity showed an increase of 25%. In addition, there is an increase of 15% in the decomposition rate of litter, suggesting increased nutrient cycling. There were significant positive correlations between herbivore diversity, foraging intensities, and functional ecosystem parameters ($r = 0.72-0.81$; $p < 0.05$).

Discussion

It can be clearly seen that the restoration of degraded grasslands with large herbivores increases the diversity of large herbivores significantly, affects feeding behavior, and enhances the functionality of the ecosystem. Species richness and species evenness of the rewilded regions have increased because of the successful restoration of the herbivore communities; similar results being found in other rewilding experiments conducted both in savannahs and temperate grasslands (Garrido et al., 2019; Cromsigt et al., 2018; Rincon-Madroñero et al., 2024). Moreover, herbivores act as important vegetation structurers, possibly because of increasing foraging area and selection of nutrient patches, leading to vegetation regeneration and ecological interactions.

There are many other ways in which herbivores influence the functioning of an ecosystem, such as soil nutrients, increased primary production, and higher litter decomposition rates in rewilded sites (Patil, 2018; van Klink et al., 202; Marks et al., 2024). All these facts support the conclusions made by previous studies, which revealed that the role of herbivores in grasslands is to act as a keystone species, influencing the structure and nutrient flow within the ecosystem. There are

certain management implications that could be mentioned here regarding the necessity to conduct rewilding programs within degraded regions.

This research has been confined to time and is likely to have been influenced by site-specific factors that could have affected the behavior of the herbivores. It is important to determine the seasonal effects, population stability, and cumulative effects of rewilding on the performance of the ecosystem functions (Singh & Joshi, 2025; Perino et al., 2019; Veerappan, 2024). Predator-prey interaction and climate variables should be introduced in subsequent studies to gain insights into the overall functioning of the grassland ecosystem. This study brings out the importance of rewilding as an effective approach to biodiversity conservation (Svenning et al., 2019; Svenning et al., 2024).

Conclusion and Future Directions

It has been proven that rewilding grasslands can bring many ecological benefits, including increasing the diversity of herbivorous fauna, increasing the activity of herbivores, and increasing ecosystem function, such as nutrient cycling and primary productivity. It can be concluded from the results that it is possible to restore ecological relationships in nature, improve vegetation diversity, and improve the resilience of ecosystems. Rewilding opens up the possibility of more active activity of herbivorous animals in previously unused places, which helps to recover plant communities and shows the connection between fauna and habitat structure. It is required to study the sustainability and

permanence of newly restored populations of herbivores in order to understand how they affect the process in the future. Taking into consideration climate variability in the rewilding process will facilitate future predictions of herbivore ecosystem functional responses to climatic changes. The socio-ecological framework involving the impact of humans on the landscape, stakeholder involvement, and conservation regulations could enhance the rewilding process further, thus ensuring sustainability. It seems important to have a greater insight into the process of ecosystem recovery, which requires expanding the scope of research into multi-trophic processes and trait analysis. Overall, the findings of the present study suggest that rewilding may prove an effective tool for conserving degraded grasslands.

References

- [1] Atkinson, Joe, Rachael Gallagher, Szymon Czyżewski, Matthew Kerr, Jonas Trepel, Robert Buitenwerf, and Jens-Christian Svenning. "Integrating functional traits into trophic rewilding science." *Journal of Ecology* 112, no. 5 (2024): 936-953. <https://doi.org/10.1111/1365-2745.14307>
- [2] Bakker, Elisabeth S., and Jens-Christian Svenning. "Trophic rewilding: impact on ecosystems under global change." *Philosophical Transactions of the Royal Society B: Biological Sciences* 373, no. 1761 (2018). <https://doi.org/10.1098/rstb.2017.0432>
- [3] Cromsigt, Joris PGM, Mariska Te Beest, Graham IH Kerley, Marietjie Landman,

- Elizabeth Le Roux, and Felisa A. Smith. "Trophic rewilding as a climate change mitigation strategy?." *Philosophical Transactions of the Royal Society B: Biological Sciences* 373, no. 1761 (2018): 1-12.
<https://doi.org/10.1098/rstb.2017.0440>
- [4] Cromsigt, Joris PGM, Yvonne JM Kemp, Esther Rodriguez, and Hubert Kivit. "Rewilding Europe's large grazer community: how functionally diverse are the diets of European bison, cattle, and horses?" *Restoration Ecology* 26, no. 5 (2018): 891-899.
<https://doi.org/10.1111/rec.12661>
- [5] Garrido, Pablo, Anders Mårell, Erik Öckinger, Anna Skarin, Anna Jansson, and Carl-Gustaf Thulin. "Experimental rewilding enhances grassland functional composition and pollinator habitat use." *Journal of Applied Ecology* 56, no. 4 (2019): 946-955.
<https://doi.org/10.1111/1365-2664.13338>
- [6] Jepson, Paul R. "De-extinction beyond species: Restoring ecosystem functionality through large herbivore rewilding." *Cambridge Prisms: Extinction* 3 (2025): e3.
- [7] Kristensen, Jeppe A., Jens-Christian Svenning, Katerina Georgiou, and Yadvinder Malhi. "Can large herbivores enhance ecosystem carbon persistence?" *Trends in Ecology & Evolution* 37, no. 2 (2022): 117-128.
<https://doi.org/10.1016/j.tree.2021.09.006>
- [8] Marks, E. A. N., J. M. Barbosa, Fuensanta Garcia-Orenes, Jorge Mataix-Solera, V. I. C. T. O. R. I. A. Arcenegui, S. Albolafio, M. Velamazán, Minerva García-Carmona, and Jose Antonio Sanchez-Zapata. "Ungulate herbivores promote contrasting modifications of soil properties and organic carbon stabilization in a grazed grassland versus rewilded woodland environment." *Agriculture, Ecosystems & Environment* 367 (2024): 108983.
<https://doi.org/10.1016/j.agee.2024.108983>
- [9] Patil, Parashram Jakappa. "An ecological analysis of forest accounting." *Environmental Analysis & Ecology Studies* 4, no. 2 (2018): 1-9.
<https://doi.org/10.9756/IAJIR/V5I1/1810010>
- [10] Perino, Andrea, Henrique M. Pereira, Laetitia M. Navarro, Néstor Fernández, James M. Bullock, Silvia Ceașu, Ainara Cortés-Avizanda et al. "Rewilding complex ecosystems." *Science* 364, no. 6438 (2019): eaav5570.
<https://doi.org/10.1126/science.aav5570>
- [11] Rincon-Madroño, Marina, Jose Antonio Sánchez-Zapata, Xavier Barber, and Jomar M. Barbosa. "Long-term vegetation responses to climate depend on the distinctive roles of rewilding and traditional grazing systems." *Landscape Ecology* 39, no. 1 (2024): 1.
<https://doi.org/10.1007/s10980-024-01806-2>
- [12] Sandom, Christopher J., Owen Middleton, Erick Lundgren, John Rowan, Simon D. Schowanek, Jens-Christian Svenning, and Søren Faurby. "Trophic rewilding presents

- regionally specific opportunities for mitigating climate change." *Philosophical Transactions of the Royal Society B: Biological Sciences* 375, no. 1794 (2020).
<https://doi.org/10.1098/rstb.2019.0125>
- [13] Singh, Praveen, and Nalini Joshi. "Impact of Climate Change on Freshwater Biodiversity in Tropical River Ecosystems." *Aquatic Ecosystems and Environmental Frontiers* 3, no. 3 (2025): 21-24.
<https://doi.org/10.70102/AEEF/V3I3/5>
- [14] Svenning, Jens-Christian, Michael Munk, and A. N. D. R. E. A. S. Schweiger. "Trophic rewilding: ecological restoration of top-down trophic interactions to promote self-regulating biodiverse ecosystems." *Rewilding* 26 (2019): 66.
- [15] Svenning, Jens-Christian, Robert Buitenwerf, and Elizabeth Le Roux. "Trophic rewilding as a restoration approach under emerging novel biosphere conditions." *Current Biology* 34, no. 9 (2024): R435-R451.
<https://doi.org/10.1016/j.cub.2024.02.044>
- [16] van Klink, Roel, Jitske van Laar-Wiersma, Oscar Vorst, and Christian Smit. "Rewilding with large herbivores: Positive direct and delayed effects of carrion on plant and arthropod communities." *PloS one* 15, no. 1 (2020): e0226946.
<https://doi.org/10.1371/journal.pone.0226946>
- [17] Veerappan, Saravanakumar. "Functional Traits and Ecological Niches: Reimagining Restoration Ecology under Climate Pressure." *National Journal of Forest Sustainability and Climate Change* (2024): 38-46.