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Herbaceous Phytosociological Characters in Forested Stream of Nagaland, North-East India

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Abstract

This study assessed the phytosociological characteristics and diversity patterns of herbaceous vegetation along the upstream and downstream sections of the Khichi Ghoki stream in Zunheboto district, Nagaland. 30 herbaceous species (17 families) were recorded using quadrat-based sampling across two hydrologically distinct zones. Asteraceae emerged as the dominant family, reflecting its ecological adaptability and prevalence in subtropical and disturbed habitats. Quantitative analysis revealed distinct spatial variations in species composition and dominance. Phegopteris connectilis, Ageratum conyzoides, and Bidens pilosa were the most influential species in both zones, with markedly higher IVI values in the downstream area. Diversity assessment indicated higher species richness (S = 30), Shannon–Wiener diversity (H′ = 3.019), and evenness (E = 0.888) in the upstream zone, whereas downstream vegetation exhibited reduced diversity (H′ = 2.617) and increased dominance (D = 0.104), likely due to disturbance and canopy openness. These findings demonstrate that anthropogenic pressures significantly shape herbaceous community structure in riparian systems. The study underscores the importance of conserving less disturbed upstream habitats and managing invasive species to maintain ecological stability in Nagaland's fragile hilly landscapes.

Keywords: *Herbaceous vegetation; Phytosociology; Species diversity; Riparian ecosystem; Invasive species; Importance Value Index; Nagaland.*

Introduction

Vegetation composition and diversity reflect the ecological conditions of a site and its interaction with environmental gradients. Phytosociological analysis provides a quantitative framework to evaluate such species composition, dominance, and distribution, offering insights into their structure and function of plant communities under varying environmental conditions [1]. Such studies are particularly useful in fragile hill ecosystems where land-use intensity, moisture gradients, and anthropogenic disturbance significantly influence vegetation dynamics [2].

Herbaceous species form a vital component of riparian and forest-edge ecosystems, contributing significantly to primary productivity, soil stabilization, and nutrient cycling. Their diversity and abundance are closely governed by edaphic and microclimatic factors such as soil moisture, light availability, and disturbance intensity. Studies across the Indian Himalayan region have shown that shifts in these parameters often lead to distinct community assemblages and variation in diversity indices [3-5]. Phytosociological assessment of herbaceous vegetation, therefore, serves as an effective tool to monitor ecological stability and habitat quality.

Nagaland, forming part of the Indo-Myanmar Biodiversity Hotspot, supports diverse vegetation types along sharp elevational gradients. The Khichi Ghoki stream, located in Zunheboto district and flowing through Lumami village, represents an important ecological corridor sustaining both biodiversity and local livelihoods. The riparian vegetation plays a crucial role in maintaining stream bank stability, regulating hydrological flow, and supporting nutrient cycling. However, increasing anthropogenic pressure, agricultural encroachment, and localized disturbances have led to changes in the structure and composition of the herbaceous community.

Understanding spatial variations of the herbaceous vegetation along hydrological gradients is vital for local biodiversity conservation and for interpreting vegetation–environment relationships in hilly terrain.

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Hence, the present study was undertaken to compare the phytosociological characteristics of herbaceous vegetation between the upstream and downstream regions of the Khichi Ghoki stream in Zunheboto district, Nagaland, and to assess variation in species richness, diversity and dominance in relation to human disturbances.

Materials and Methods

Study Area

The study was conducted along the Khichi Ghoki stream near Lumami village, Zunheboto district, Nagaland, India (26.2257°N, 94.4851°E). The site lies approximately 2 km from Lumami village and about 40 km from Zunheboto town. The stream, which eventually joins the Doyang River, is surrounded by subtropical forest vegetation and agricultural landscapes. The region experiences a monsoonal climate with distinct wet and dry seasons, and the riparian zone supports diverse herbaceous flora influenced by hydrological and anthropogenic factors.

Two zones were delineated for the study *viz*., 1. Upstream: representing relatively undisturbed, shaded, and moist conditions and 2. Downstream: characterized by open canopy, higher human activity, and moderate disturbance due to agricultural and domestic use.

Sampling Design and Vegetation Analysis

Phytosociological assessment was carried out using the line transect–quadrat method. In each zone (upstream and downstream), ten 1 × 1 m quadrats were laid randomly along the stream margins, giving a total of 20 quadrats. Within each quadrat, all herbaceous species were identified, counted, and photographed for reference. Species identification followed standard regional floras and taxonomic keys [6-10].Standard phytosociological parameters i.e.,frequency, density, abundance, and basal area were computed using the formulae of Curtis and McIntosh [11]. The Importance Value Index (IVI) of each species was derived as the sum of its relative frequency (RF), relative density (RD), and relative dominance (Rdo).

Table 1: Quantitative analysis of herbs recorded in upstream area of KhichiGhoki stream

S. No	Plant Species	PF	RF	D	RD	BA	R.Do	IVI
1	*Ageratum conyzoides* (L.)	60	4.16	1.6	15.8	0.62	1.20	21.16
2	*Ageratina adenophora* (Spreng.) R.M. King & H. Rob.	40	2.77	0.7	0.95	1.94	3.77	7.49
3	*Acmella uliginosa* (Swartz) Cass.	40	2.77	1.1	1.49	2.51	4.88	9.14
4	*Boehmeria nivea* (L.) Gaudich.	40	2.77	1.0	1.36	0.78	1.51	5.64
5	*Bidens pilosa* (L.)	70	4.86	4.6	6.26	4.71	9.16	20.28
6	*Blumea lacera* (Burm.f.) DC.	60	4.16	6.1	8.31	0.84	1.63	14.10
7	*Curculigo orchioides* Gaertn.	60	4.16	1.7	2.31	1.57	3.05	9.52
8	*Curcuma longa* (L.)	10	0.69	0.1	0.13	1.16	2.25	3.07
9	*Commelina benghalensis* (L.)	50	3.47	2.1	2.86	0.94	1.82	8.15
10	*Commelina diffusa* Burm.	60	4.16	1.6	2.17	0.72	1.40	7.73
11	*Centella asiatica* (L.)	40	2.77	2.1	2.86	1.25	2.43	8.06
12	*Camonea vitifolia* A.R. Simões & Staples	40	2.77	1.2	1.63	1.28	2.49	6.89
13	*Dichrocephala integrifolia* (L.f.) Kuntze	40	4.16	1.7	2.31	0.47	0.91	7.38
14	*Desmodium adscendens* (Sw.) DC.	40	2.77	1.7	2.31	0.94	1.82	6.90
15	*Erigeron floribundus* (Kunth) Sch. Bip.	30	2.08	4.2	5.72	4.30	8.36	16.16
16	*Eranthemum pulchellum* Andrews	70	4.86	1.5	2.04	0.40	0.77	7.67
17	*Gynura procumbens* (Lour.)	60	4.16	1.6	2.17	2.19	4.26	10.59
18	*Gynura crepidioides* (Benth.) S. Moore	60	4.16	2.5	3.40	1.47	2.85	10.41
19	*Melissa officinalis* (L.) (Lemon balm)	40	2.77	1.5	2.04	1.88	3.65	8.46
20	*Lobelia terminalis* Clarke	30	2.08	0.6	0.81	2.07	4.02	6.91
21	*Oxalis latifolia* Kunth	60	4.16	4.2	5.72	0.94	1.82	11.60
22	*Oxybasis glauca* (L.) S. Fuentes, Uotila & Borsch	50	3.47	0.9	1.22	0.34	0.66	5.35
23	*Oxalis corniculata* (L.)	40	2.77	0.8	1.08	1.16	2.25	6.10
24	*Phegopteris connectilis* (Michx.) Watt	70	4.86	7.6	10.35	4.71	9.16	24.37
25	*Pseudognaphalium affine* Anderb.	60	4.16	1.5	2.04	5.02	9.76	15.96
26	*Plantago major* (L.)	20	1.38	0.4	0.54	1.47	2.85	4.77
27	*Phyllanthus urinaria* (L.)	40	2.77	0.7	0.95	1.00	1.94	5.66
28	*Urena lobata* (L.)	40	2.77	0.8	1.08	0.65	1.26	5.11
29	*Veronica javanica* Blume	50	3.47	4.0	5.44	1.88	3.65	12.56
30	*Youngia japonica* (L.) DC.	50	3.47	2.4	3.26	2.19	4.26	10.99

Table 2: Quantitative analysis of herbs recorded in downstream area of KhichiGhoki stream

S. No	Plant Species	PF	RF	D	RD	BA	R. Do	IVI
1	*Ageratum conyzoides* (L.)	50	6.09	11.4	22.14	2.90	8.90	37.13
2	*Acmella uliginosa* (Swartz) Cass.	50	6.09	1.8	3.49	1.25	3.84	13.42
3	*Boehmeria nivea* (L.) Gaudich.	30	3.66	0.6	1.17	4.39	13.48	18.31
4	*Bidens pilosa* (L.)	30	3.66	3.0	5.82	5.65	17.35	26.83
5	*Blumea lacera* (Burm.f.) DC.	40	4.88	3.3	6.40	0.94	2.89	14.17
6	*Curculigo orchioides* Gaertn.	40	4.88	1.0	1.94	1.47	4.51	11.33
7	*Commelina benghalensis* (L.)	30	3.66	0.5	0.97	1.69	5.19	9.82
8	*Commelina diffusa* Burm.	30	3.66	0.9	1.75	1.90	5.83	11.24
9	*Centella asiatica* (L.)	40	4.88	2.7	5.24	1.03	3.16	13.28
10	*Commelina vitifolia* A.R. Simões & Staples	40	4.88	3.1	6.02	0.31	0.95	11.85
11	*Dichrocephala integrifolia* (L.f.) Kuntze	30	3.66	0.6	1.17	0.94	2.89	7.72
12	*Desmodium adscendens* (Sw.) DC.	30	3.66	1.4	2.72	0.31	0.95	7.33
13	*Gynura procumbens* (Lour.)	50	6.09	1.3	2.52	1.191	3.65	12.26
14	Lemon balm (L.)	40	4.88	1.3	2.52	1.25	3.84	11.24
15	*Oxalis latifolia* Kunth	40	4.88	1.3	2.52	1.881	5.78	13.18
16	*Oxalis corniculata* (L.)	40	4.88	1.6	3.10	0.37	1.14	9.12
17	*Phegopteris connectilis* (Michx.) Watt	50	6.09	7.7	14.95	2.38	7.31	28.35
18	*Phyllanthus urinaria* (L.)	30	3.66	0.6	1.17	0.69	2.12	6.95
19	*Urena lobata* (L.)	40	4.88	0.7	1.36	0.78	2.39	8.68
20	*Veronica javanica* Blume	50	6.09	5.5	10.68	1.57	4.82	21.59
21	*Youngia japonica* (L.) DC.	40	4.88	1.2	2.33	0.62	1.90	9.11

PF= Percentage frequency, RF= Relative frequency (%), D= Density (m^2/plant), RD= Relative Density (%) , BA= Basal area ($cm^{-2}m^{-2}$), R. Do= Relative dominance (%) and IVI= Important Value Index

Phytosociological Attributes

Upstream and downstream zones showed distinct variation in species dominance. In the upstream zone, *Phegopteris connectilis* exhibited the highest IVI (24.37), followed by *Ageratum conyzoides* (21.16) and *Bidens pilosa* (20.28). The lowest IVI was recorded for *Curcuma longa* (3.07). In contrast, the down stream zone was dominated by *Ageratum conyzoides* (IVI = 37.13), *Phegopteris connectilis* (28.35), and *Bidens pilosa* (26.83), while *Phyllanthus urinaria* (6.95) recorded the lowest IVI. The dominance of *Ageratum conyzoides* and *Bidens pilosa* in the downstream site may be attributed to their disturbance-tolerant and invasive nature, thriving in open and nutrient-rich environments [18]. Conversely, the presence of *Phegopteris connectilis* in shaded upstream areas reflects its preference for moist and less disturbed microhabitats. Similar distributional trends have been documented in riparian herb communities of the Eastern Himalaya [19].

Diversity Indices

The upstream zone exhibited higher species richness (S = 30) and diversity (H′ = 3.019) compared to downstream (S = 21, H′ = 2.617). Simpson's dominance index was lower in the upstream site (D = 0.067) than in the downstream (D = 0.104), indicating greater evenness and reduced dominance. Correspondingly, Pielou's evenness index was slightly higher in the upstream (E = 0.888) than downstream (E = 0.860).These results suggest that the upstream vegetation is more heterogeneous and ecologically stable, whereas the downstream community exhibits reduced diversity and higher dominance due to disturbance pressure. Comparable findings were reported by Kumar & Verma [20] and Bhat et al. [5], who noted that human intervention and open canopy conditions often favor a few aggressive species, reducing overall species evenness.

Table 3: Diversity indices recorded at KichiGhoki stream in upstream

Indices	Value
Species Richness ((S)	30
Simpson's Index (D)	0.067
Index of Similarity (1-D)	0.933
Reciprcal Index (1/D)	14.925
Shannon-Wiener Index (H′)	3.019
Pielou's Evenness Index (E)	0.888

Table 4: Diversity indices recorded at Kichighoki stream in downstream

Indices	Value
Species Richness ((S)	21
Simpson's Index (D)	0.104
Index of Similarity (1-D)	0.896
Reciprocal Index (1/D)	9.615
Shannon-Wiener Index (H′)	2.617
Pielou's Evenness Index (E)	0.86

Ecological Interpretation

The contrast between upstream and downstream vegetation reflects the influence of hydrological and anthropogenic gradients on community organization. Upstream areas, being shaded and moist, promote species coexistence and niche differentiation. Downstream sites, exposed to periodic disturbance and resource enrichment, encourage dominance of opportunistic herbs such as *Ageratum conyzoides*, indicative of successional or disturbed-stage communities.Higher Shannon and lower Simpson indices in the upstream area indicate greater resilience and lower competition, while the reduced diversity downstream signals incipient habitat homogenization. Similar upstream–downstream contrasts in herbaceous diversity have been documented in riparian systems across the Indo-Myanmar region [15, 21].

Conclusion

The present study revealed distinct variation in herbaceous plant composition and diversity between the upstream and

downstream regions of the Khichi Ghoki stream in Zunheboto district, Nagaland. A total of 30 species belonging to 17 families were recorded, with Asteraceae emerging as the most dominant family. The upstream zone exhibited higher species richness, diversity and evenness, indicating a more heterogeneous and ecologically stable habitat compared to the downstream area, which showed reduced diversity and greater dominance of disturbance-tolerant species such as *Ageratum conyzoides*. These findings highlight the influence of disturbance gradients on herbaceous community structure in riparian ecosystems. Conservation measures emphasizing the protection of less disturbed upstream habitats and the control of invasive species are essential to sustain the ecological integrity of riparian zones in Nagaland's hilly terrain. Continuous monitoring of vegetation dynamics will further aid in understanding long-term changes under increasing anthropogenic pressures.

References

1. Rawat, D. S., &Pangtey, Y. P. S. (2022). Plant diversity and phytosociological structure in fragile Himalayan ecosystems: Influence of microclimatic and edaphic factors. *Botanical Studies, 63*(1), 37–49. https://doi.org/10.1186/s40529-022-00352-9
2. Sharma, A., Tripathi, O. P., & Khan, M. L. (2023). Herbaceous vegetation composition, diversity, and their linkages with soil moisture and anthropogenic disturbance in North-East India. *Flora, 301*, 151932. https://doi.org/10.1016/j.flora.2022.151932
3. Ullah, T., Muhammad, Z., Ullah, R., Jelani, G., Ur, M., Rahman, A. M., & Zaman, K. (2019). Vegetation structure and species diversity of the herbaceous layer in different phytosociological habitats of Daudzai, Peshawar.*Journal of Xi'an Shiyou University, Natural ScienceEdition*,*19*(2), 155-178.
4. Upadhaya, K., Pandey, H. N., &Tripathi, R. S. (2006). Understory plant diversity in subtropical humid forest of Meghalaya. *International Journal of Ecology and Environmental Sciences, 32*(2), 207–219.
5. Bhat, J. A., Malik, Z. A., Kumar, M., Dar, M. A., Negi, A. K., &Todaria, N. P. (2021). Herbaceous diversity along the altitudinal gradient in a protected area. In *Diversity and dynamics in forest ecosystems* (pp. 117–138). Apple Academic Press.
6. Bentham, G., & Hooker, J. D. (1862–1883). *Genera plantarum: Ad exemplariaimprimis in HerberiisKewensibusservatadefinita* (Vols. 1–3). A. Black; Reeve & Co.
7. Prain, D. (1903). *Bengal plants: A list of the phanerogams, ferns and fern-allies indigenous to, or commonly cultivated in, the Lower Provinces and Chittagong* (Vols. 1–2). Botanical Survey of India.
8. Bor, N. L. (1960). *Grasses of Burma, Ceylon, India and Pakistan*. Pergamon Press.
9. Bennet, S. S. R. (1987). *Name changes in flowering plants of India and adjacent regions*. Triseas Publishers.
10. Chen, X., Liu, Y., Liu, H., Wang, H., Yang, D., &Huangfu, C. (2015). Impacts of four invasive Asteraceae on soil physico-chemical properties and AM fungi community. *American Journal of Plant Sciences, 6*(17), 2740–2751. https://doi.org/10.4236/ajps.2015.617274
11. Kanjilal, U. N., Kanjilal, P. C., Das, A., De, R. N., &Bor, N. L. (1934–1940). *Flora of Assam* (Vols. 1–5). Government of Assam; Allied Book Centre.
12. Curtis, J. T., & McIntosh, R. P. (1950). The interrelations of certain analytic and synthetic phytosociological characters. *Ecology, 31*(3), 434–455. https://doi.org/10.2307/1931497
13. Shannon, C. E., & Weaver, W. (1963). *The mathematical theory of communication*. University of Illinois Press.
14. Pielou, E. C. (1966). The measurement of diversity in different types of biological collections. *Journal of Theoretical Biology, 13*(1), 131–144. https://doi.org/10.1016/0022-5193(66)90013-0
15. Simpson, E. H. (1949). Measurement of diversity. *Nature, 163*(4148), 688. https://doi.org/10.1038/163688a0
16. Boruah, T., Chakravarty, P., &Deka, H. (2020). Phytosociology and antioxidant profile study for selecting potent herbs for phytoremediation of crude oil–contaminated soils. *Environmental Monitoring and Assessment, 192*(12), 766.
17. Roeble, L., van Benthem, K. J., Weigelt, P., &Kreft, H. (2024). Island biogeography of the megadiverse plant family Asteraceae. *Nature Communications, 15*, 7276. https://doi.org/10.1038/s41467-024-51556-7
18. Mandal, G., & Joshi, S. P. (2015). Eco-physiology and habitat invasibility of an invasive, tropical shrub (Lantana camara) in western Himalayan forests of India. Forest Science and Technology, 11(4), 182–196. https://doi.org/10.1080/21580103.2014. 990062
19. Wei, H., Yan, W., Quan, G., Zhang, J., & Liang, K. (2017). Soil microbial carbon utilization, enzyme activities and nutrient availability responses to *Bidenspilosa* and a non-invasive congener under different irradiances. *Scientific Reports, 7*, 11309. https://doi.org/10.1038/s41598-017-11707-x
20. Haq, S. M., Amjad, M. S., Waheed, M., Bussmann, R. W., Ali, K., & Jones, D. A. (2023). Vegetation communities and identification of indicator species in the riparian areas of Zabarwan mountain range in the Kashmir Himalaya. *Environmental and Sustainability Indicators, 19*, 100277. https://doi.org/10.1016/j.indic.2023.100277
21. Kumar, R., Verma, R. K., Kumari, K., Kumar, V., &Gulshan, K. R. (2020). Impact of controlled burning on herbs in high altitude zone of Chirpine forests in Solan and Nahan circles, Himachal Pradesh. *International Journal of Bio-resource and Stress Management, 11*(4), 414–424.
22. Keretsu, K., Singh, M. R., &Temjen, W. (2025). Herbaceous riparian ecotonal species along the Dzücha River, Kohima, Nagaland and their ethnomedicinal uses. Agricultural Science Digest, *45*(5), 891–896. https://doi.org/10.18805/ag.D-5558