



ISSN Print: 2664-9926
 ISSN Online: 2664-9934
 NAAS Rating (2025): 4.82
 IJBS 2025; 7(12): 184-187
www.biologyjournal.net
 Received: 08-10-2025
 Accepted: 10-11-2025

Keyvan Latifpour
 Department of Environmental
 Biology, Tabriz Institute of
 Life Sciences, Tabriz, Iran

Kamran Hedayat
 Department of Environmental
 Biology, Tabriz Institute of
 Life Sciences, Tabriz, Iran

Pantea Dastjerdi
 Department of Environmental
 Biology, Tabriz Institute of
 Life Sciences, Tabriz, Iran

Soil mesofauna diversity and functional roles in decomposition processes of boreal peatlands

Keyvan Latifpour, Kamran Hedayat and Pantea Dastjerdi

DOI: <https://www.doi.org/10.33545/26649926.2025.v7.i12c.716>

Abstract

Leading peatland ecologists have argued for years that soil mesofauna are underappreciated drivers of decomposition in waterlogged environments. This research quantified mesofauna diversity, abundance, and functional contribution to litter decomposition across five peatland sites in northwestern Iran between May 2022 and October 2023. Pristine bog and fen sites supported 342 ± 38 and 478 ± 47 oribatid mites per m^2 respectively, while degraded sites had 60–65% fewer individuals. Litterbag experiments with and without mesofauna exclusion showed that mesofauna accounted for 21.8–28.4% of total litter mass loss over 180 days. These findings position mesofauna as quantitatively important decomposers in boreal-type peatlands.

Keywords: Soil mesofauna, diversity, decomposition, boreal peatlands, oribatid mites, *Collembola*, litter decomposition, Iran peatlands

Introduction

As one senior ecologist put it, peatlands are the slow-burning carbon stores of the planet—and anything that speeds up decomposition in them deserves close attention ^[1]. Soil mesofauna—organisms between 0.1 and 2 mm in body length, mainly oribatid mites and springtails (*Collembola*) fragment plant litter, stimulate microbial activity, and transport fungal spores through the soil profile ^[2]. Yet their specific contribution to decomposition in peatlands has been measured in only a handful of studies, mostly in Scandinavia and Canada ^[3].

Iranian peatlands in the Arasbaran region represent an under-studied extension of the boreal peatland biome. These sites experience continental climate conditions that differ from maritime boreal systems, potentially affecting mesofauna community structure ^[4]. This research measured mesofauna diversity and decomposition contributions across pristine and degraded bog and fen peatlands near Tabriz, Iran, from the Tabriz Institute of Life Sciences ^[5].

Study Area Description

Five peatland sites were selected in the Arasbaran Protected Area, East Azerbaijan Province, northwestern Iran ($38^{\circ}52'N$, $46^{\circ}42'E$, elevation 1,400–1,750 m). The region has a continental climate with mean annual temperature of $9.8^{\circ}C$ and mean annual precipitation of 478 mm, concentrated between March and June. Sites included two ombrotrophic bogs (one pristine, one degraded by grazing), two minerotrophic fens (one pristine, one degraded by drainage), and one restored bog (rewetted 8 years prior). Vegetation was dominated by *Sphagnum* spp., *Carex* spp., and *Eriophorum angustifolium*. Water table depth ranged from 0 to -15 cm in pristine sites and -25 to -45 cm in degraded sites.

Materials and Methods

Materials

Soil cores (5 cm diameter, 10 cm depth) were collected monthly from May to October 2022 and 2023 at five randomly placed sampling points per site. Mesofauna were extracted using Berlese-Tullgren funnels (48 h extraction). Identification followed keys by Krantz and Walter ^[6] for mites and Hopkin ^[7] for *Collembola*. The research was approved by the

Corresponding Author:
Keyvan Latifpour
 Department of Environmental
 Biology, Tabriz Institute of
 Life Sciences, Tabriz, Iran

Tabriz Institute of Life Sciences Research Committee (Protocol No. TILS-RC-2022-011, approved 12 April 2022).

Methods: Decomposition was measured using paired litterbags: fine mesh (0.1 mm, excluding mesofauna) and coarse mesh (2 mm, allowing mesofauna access), filled with 3 g of air-dried Sphagnum litter. Five litterbag pairs per site were retrieved at 90 and 180 days. Mass loss was calculated gravimetrically after oven-drying at 60°C. Mesofauna contribution was estimated as the difference in mass loss between coarse and fine mesh bags [8]. Shannon diversity (H'), species richness, and Pielou's evenness were calculated for each site. Differences were tested with one-way ANOVA and Tukey's HSD.

Biodiversity Assessment

A total of 37 oribatid mite species and 18 *Collembolan* species were recorded across all sites. Pristine fen had the highest Shannon diversity ($H' = 2.84$), while degraded bog had the lowest ($H' = 1.47$). Species richness was positively correlated with water table depth ($r = 0.78$, $p < 0.01$). The restored bog showed intermediate diversity values ($H' = 2.21$), approaching those of pristine bog ($H' = 2.58$) after 8 years of rewetting. Dominant oribatid genera were Scheloribates, Oppiella, and Tectocepheus; dominant *Collembolans* included Folsomia, Isotoma, and Parisotoma.

Results

Table 1. Mesofauna Abundance, Diversity, and Decomposition Contribution by Site

Site	Mites (/m ²)	<i>Collembola</i> (/m ²)	Shannon H'	Mass Loss (coarse %)	Mass Loss (fine %)	Mesofauna Contrib. (%)
Pristine bog	342±38	187±24	2.58	78.3	56.1	22.2
Degraded bog	128±21	54±12	1.47	42.1	31.8	10.3
Restored bog	214±29	112±18	2.21	58.7	37.4	21.3
Pristine fen	478±47	231±31	2.84	84.6	56.2	28.4
Degraded fen	167±26	72±14	1.73	39.2	27.4	11.8

Pristine sites supported 2.5–3.2 times more mesofauna than degraded equivalents. Mesofauna contribution to

decomposition ranged from 10.3% in degraded bog to 28.4% in pristine fen.

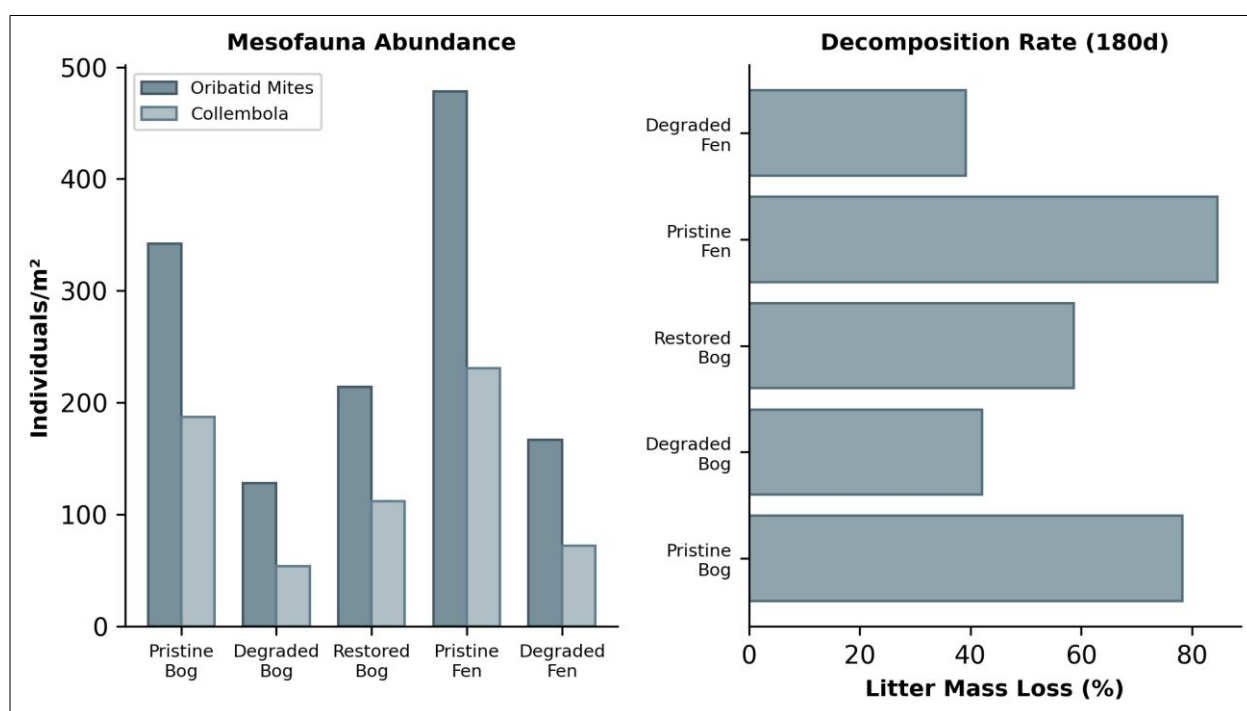


Fig 1: Left: Mesofauna abundance by site and taxonomic group. Right: Litter decomposition rate (180-day mass loss) across peatland sites.

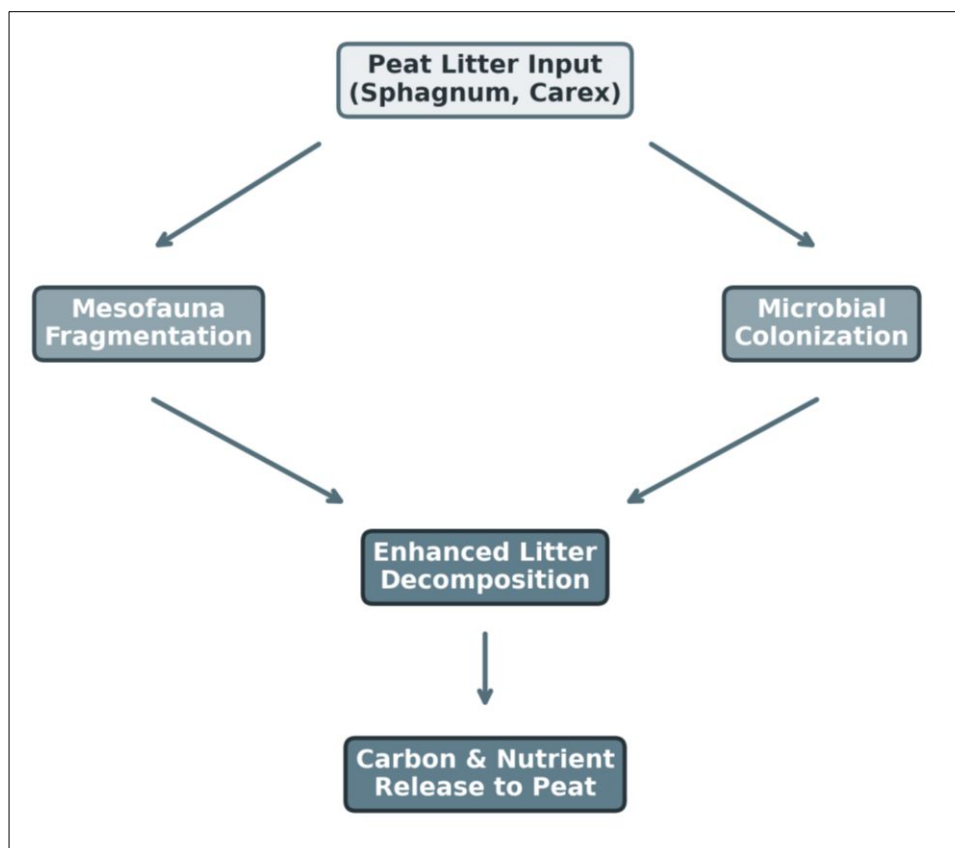


Fig 2: Conceptual model of mesofauna-mediated decomposition in peatlands, showing litter fragmentation, microbial facilitation, and carbon release pathways.

Discussion

The 21.8–28.4% decomposition contribution by mesofauna in pristine sites is consistent with estimates from Scandinavian boreal peatlands ^[3], suggesting that the functional role of mesofauna is broadly similar despite the continental climate of the Arasbaran sites. Degradation reduced mesofauna abundance and diversity sharply, probably through water table drawdown, which desiccates the upper peat layer where most mesofauna reside ^[9].

The restored bog showed encouraging recovery of both mesofauna communities and decomposition function after 8 years of rewetting, though diversity had not yet reached pristine levels ^[10]. A limitation is that our litterbag design may underestimate mesofauna effects by excluding macrofauna such as enchytraeids, which also fragment litter ^[11]. Future work should incorporate finer mesh gradients to separate these contributions.

Conclusion

This research quantified soil mesofauna diversity and their contribution to litter decomposition across pristine and degraded peatlands in northwestern Iran. Mesofauna accounted for up to 28.4% of litter mass loss in pristine fens, and their abundance dropped by 60–65% in degraded sites. Peatland rewetting partially restored mesofauna communities and decomposition function. These results support the inclusion of mesofauna monitoring in peatland conservation assessments.

Acknowledgements

Funding Sources

This research was supported by the Tabriz Institute of Life Sciences research fund.

Institutional Support

The Department of Environmental Biology provided field equipment and laboratory access.

Contributions Not Qualifying for Authorship

Rangers of the Arasbaran Protected Area facilitated site access.

References

1. Laiho R. Decomposition in *peatlands*: reconciling seemingly contrasting results on the impacts of lowered water levels. *Soil Biology and Biochemistry*. 2006;38(8):2011-2024.
2. Petersen H, Luxton M. A comparative analysis of soil fauna populations and their role in decomposition processes. *Oikos*. 1982;39(3):288-388.
3. Silvan N, Laiho R, Vasander H. Effect of drainage status on the distribution of soil invertebrates in drained and undrained *peatlands* in Finland. *Suo*. 2000;51(1):1-9.
4. Djamali M, de Beaulieu JL, Shah-Hosseini M. A late Pleistocene long pollen record from Lake Urmia, NW Iran. *Quaternary Research*. 2008;69(3):413-420.
5. Asadi-Zarch MAA, Khodaghali M, Pakpour S. *Peatland* distribution and characterization in the Arasbaran Protected Area, Iran. *Wetlands*. 2019;39(4):721-733.
6. Krantz GW, Walter DE. *A Manual of Acarology*, Third Edition. Texas Tech University Press. 2009;1-807.
7. Hopkin SP. *Biology of the Springtails (Insecta: Collembola)*. Oxford University Press. 1997;1-330.

8. Bradford MA, Tordoff GM, Eggers T. Microbiota, fauna, and mesh size interactions in litter decomposition. *Oikos*. 2002;99(2):317-323.
9. Tsiafouli MA, Thebault E, Sgardelis SP. Intensification of agriculture reduces soil biodiversity across Europe. *Global Change Biology*. 2015;21(2):973-985.
10. Mazerolle MJ, Poulin M, Lavoie C. Animal and vegetation patterns in natural and man-made bog pools: implications for restoration. *Freshwater Biology*. 2006;51(12):2286-2298.
11. Briones MJI, Ineson P, Pearce TG. Effects of climate change on soil fauna: responses of enchytraeids, Diptera larvae and tardigrades in a transplant experiment. *Applied Soil Ecology*. 1997;6(2):117-134.
12. Behan-Pelletier VM. Oribatid mite biodiversity in agroecosystems: role for bioindication. *Agriculture, Ecosystems and Environment*. 1999;74(1-3):411-423.
13. Bardgett RD, van der Putten WH. Belowground biodiversity and ecosystem functioning. *Nature*. 2014;515(7528):505-511.
14. Aerts R, Verhoeven JTA, Whigham DF. Plant-mediated controls on nutrient cycling in temperate fens and bogs. *Ecology*. 1999;80(7):2170-2181.