Uttar Pradesh Journal of Zoology

Volume 45, Issue 12, Page 173-178, 2024; Article no.UPJOZ.3538
ISSN: 0256-971X (P)

Preliminary Studies on the Invertebrate Microfauna Associated with A Terrestrial Moss, *Hyophila sp.* in Urban Areas of Chennai, Tamil Nadu, India

Vasudevan Vaishnavi [a*] and Pavithra Bharathi [a]

[a] *Ethiraj College for Women, 70, Ethiraj Salai, Thousand Lights, Chennai, Tamil Nadu-600008, India.*

Authors' contributions

This work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.

Article Information

DOI: https://doi.org/10.56557/upjoz/2024/v45i124115

Open Peer Review History:
This journal follows the Advanced Open Peer Review policy. Identity of the Reviewers, Editor(s) and additional Reviewers, peer review comments, different versions of the manuscript, comments of the editors, etc are available here: https://prh.mbimph.com/review-history/3538

Short Research Article

Received: 14/03/2024
Accepted: 18/05/2024
Published: 23/05/2024

ABSTRACT

Bryophytes provide microhabitat, optimal temperature condition, and act as reliable nutrient sources for invertebrate fauna. In the present study, microscopic analysis of the invertebrate micro fauna associated with a terrestrial moss, *Hyophila* sp. was examined. The work was conducted for a period of six months from october to march and the invertebrate microfauna was recorded for two different seasons (october-december and january – march). It was found that protozoans, rotifers, nematodes, eggs or cysts and certain larvae were present throughout the study period. However, their proportions were significantly altered during the two different seasons. Metabolically active animals were seen in higher numbers during monsoon period (October-december) compared to higher number of eggs and cysts during drier months (January –march). This study highlights the different microfaunal population associated with the urban moss, *Hyophila* sp. and adds to the growing pool of literature on moss- microfaunal association.

**Corresponding author: Email: vaishnavi_v@ethirajcollege.edu.in;*

Cite as: *Vaishnavi, V., & Bharathi, P. (2024). Preliminary Studies on the Invertebrate Microfauna Associated with A Terrestrial Moss, Hyophila sp. in Urban Areas of Chennai, Tamil Nadu, India. UTTAR PRADESH JOURNAL OF ZOOLOGY, 45(12), 173–178. https://doi.org/10.56557/upjoz/2024/v45i124115*

Keywords: Terrestrial moss; Hyophila sp.; invertebrate microfauna; bdelloid rotifers; nematodes; eggs.

1. INTRODUCTION

Bryophytes are tiny, autotrophic, non –vascular cryptogams, which are ubiquitous in distribution [1]. They are referred to as “Amphibians of the Plant Kingdom” due to their dual lives on both water and land. In the light of evolution, bryophytes are the first terrestrial plants placed between algae and vascular plants [2,3].

The world of bryophytes echoes with life, creating a habitat unlike any other [4]. They provide food as they sequester fairly a good amount of micro and macronutrients, shelter, camouflage and nesting material for variety of animal groups such as microscopic invertebrates, eggs to larger worms and insects [5]. Mosses shield invertebrates from climatic differences and gives insulation against temperature and humidity changes by creating spaces filled with air inside their tissue structure [6]. However, only limited information is available on the same.

Most of the terrestrial mosses can adapt and survive in varying degree of available moisture. They can dry almost as rapidly as the environment and resume normal metabolic activity upon supply of moisture [7]. Many aquatic invertebrates living in association with the mosses are capable of undergoing anhydrobiosis, an adaptation to survive desiccation and remoistening. Protozoans, nematodes, tardigrades, and rotifers are the dominant aquatic moss-dwelling invertebrate groups, and all require free water for activity [1] but all are capable of anhydrobiosis to tolerate periodic drought [8-10].

The invertebrate bryofauna can also be classified into micro fauna which includes microscopic organisms such as protozoans, rotifers and some nematode worms and meso/macro fauna that includes other larger nematode worms, annelids, insect larvae, insects and molluscs. Studies have shown micro fauna present in the mosses regulates bacterial populations [11] and nutrient mineralization [12]. Even among the limited literature available, most of the studies are on micro fauna associated with moss that dwells in natural systems, such as forests, river banks, mountains etc [1, 13]. With rapid urbanization throughout the globe, there are almost no studies that are available on the micro fauna associated with mosses dwelling in urban areas (man-made structures).

Thus, it is necessary that a deeper understanding on the diversity and distribution of bryophyte micro fauna in urban areas is a prerequisite for the use of these organisms in environmental monitoring. However with limited studies, the pool of information on this regard is minimal.

Therefore, the objective of the present study was to perform an initial analysis and compare the invertebrate micro fauna during two different seasons (October to December and January to march) associated with an urban dwelling, terrestrial moss, namely *Hyophila* sp.

2. MATERIALS AND METHODS

Hyophila sp. was collected from two different urban parks in Chennai, Tamil Nadu, India from the period of October 2022 to March 2023. These mosses were found growing mostly on man-made structures, such as side walk ways and stone benches. The moss samples were carefully scrapped from these area using a scalpel and the collected samples were sealed in polyethylene bags and taken to the laboratory for further analysis. All the moss samples collected were in their sporophytic stage. After bringing them to the laboratory, the soil and other debris attached to the moss samples were removed manually under dissection microscope (Fig. 1). The moisture content was analysed by checking their wet weight and dry weight difference.

Micro fauna were analyzed from the collected moss samples following the procedure of Merrifield *et al*. [14]. 2-3 g of collected moss samples were immersed in distilled water for 24 hours in a Petri dish. Each of these samples were agitated vigorously for at least 30 seconds and were squeezed by hand for about 30 times. Then the sample was placed on a strainer and the residual water was collected. A monolayer of 100 µl of this residual sample (1 cm × 1 cm) was made on a slide and a coverslip was placed to restrict the movement of the animals present. The slide was then observed under bright field optics of Magnus binocular microscope at 40X and live animals were analyzed to check the different groups of microscopic fauna present in the sample. The animals were also enumerated and the relative percentage of different groups of these microscopic organisms were calculated. In addition, the different groups of invertebrate micro fauna were compared between wet and dry season.

Fig. 1. Photomicrograph of *Hyophila* sp. under dissection microscope

3. RESULTS

Fig. 1 shows the photomicrograph of the moss, *Hyophila.* The moisture content of the moss, *Hyophila* sp. showed considerable difference between the wet and the dry season. The moisture content was 58 % during the wet season compared to 36 % during drier months.

The invertebrate micro fauna were analyzed and compared from the moss sample, *Hyophila* sp. It is to be noted that there was not much difference between the micro fauna collected from two of the sample sites. In general, protozoans, rotifers, nematodes, eggs or cysts and certain larvae were observed in the samples collected from the period of October to march (Fig. 2). Atleast 3 different species of rotifers (bdelloid rotifers being the most dominant), a single type of protozoan and 2 different species of nematodes were observed. However, there was a significant difference in the occurrence of these organisms with different seasons (Fig. 3). During monsoon period, there was a high population of active, moving animals. The invertebrate life during the wet season was highly vibrant with metabolically active animals. However, very few cysts, eggs and larvae were observed during this period and the relative abundance showed rotifers (~ 65 %) being the most dominant group followed by ciliates and nematodes.

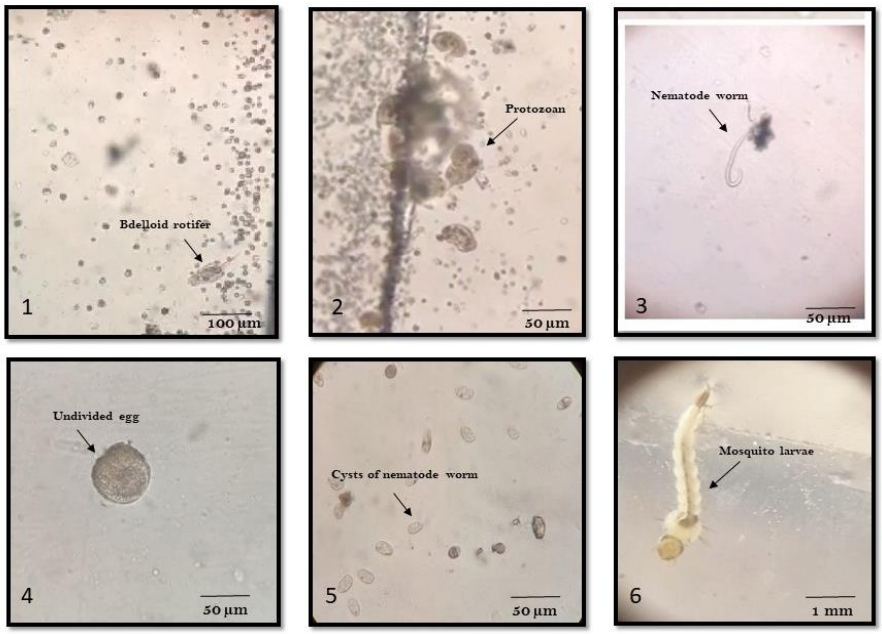

Fig. 2. Photomicrographs of various microfauna associated with the terrestrial moss *Hyophila* sp

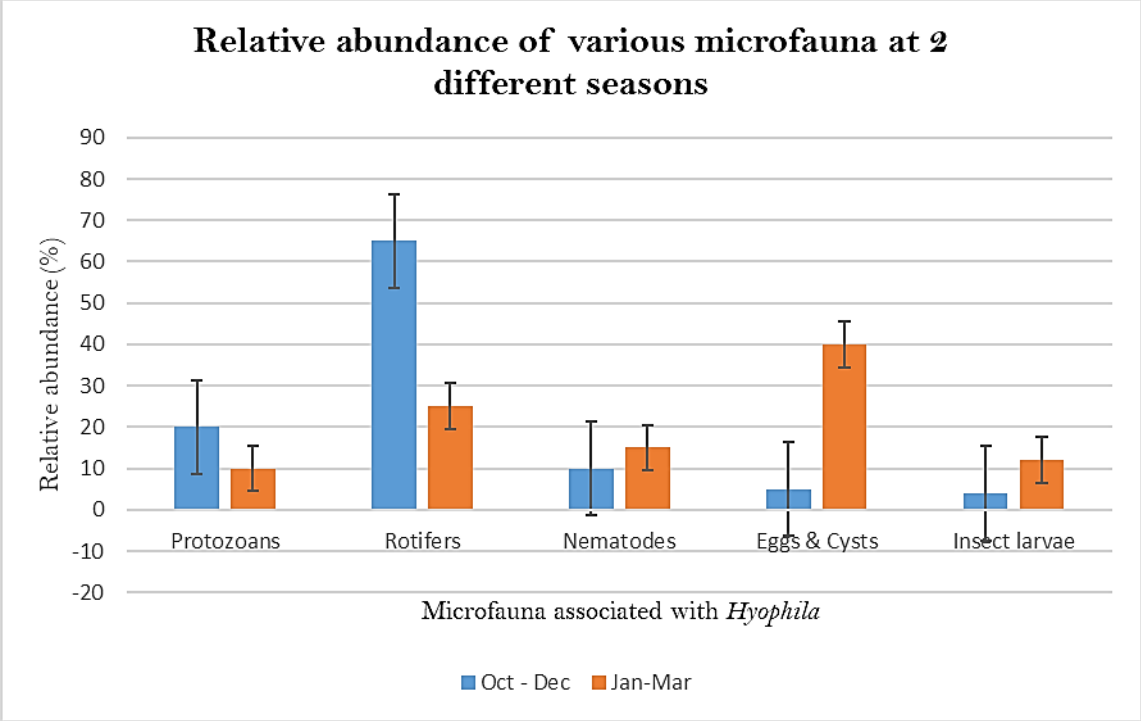

Fig. 3. Comparison of invertebrate micro fauna between 2 different seasons Each Bar Represents relative percentage ± SE

During the post monsoon period/dry season, we were still able to identify rotifers, ciliates and nematodes. However, there was a substantial population of eggs, cysts and also some insect larvae. The microscopic life during the dry season was more stagnant with a very few metabolically active animals. The number of cysts and eggs in dry sample were much higher when compared to active live animals. It was pertinent to note that we were not able to observe any occurrence of tardigrade species in any of our samples.

4. DISCUSSION

Bryophytes are primitive plants which are under rated for their ecological role. Not many studies are available on these non-vascular plants. Mosses, one of most abundant and ubiquitous bryophytes found in various natural and man-made habitats often go underappreciated and overlooked. They contribute in nutrient cycling, maintenance of food web, work as bio monitors etc [14]. In addition, they also play an important role in sustaining the lives of number of micro, meso and macro fauna by providing safe nesting site, optimal temperature conditions and act as rich nutrient source [6, 15]. Studies on moss micro fauna is not very common, and whatever studies that are available are on moss associated fauna in natural habitats, such as forest floor, streams, mountains etc [1,13,16]. However, almost no significant studies are reported on fauna associated with moss dwelling on man-made structures

In the present study moss growing in urban parks of Chennai was chosen and the taxonomic identity was found to be *Hyophila* sp. This moss is a type of acrocarpous (pinnate) moss that belongs to the family of Pottiaceae, and are commonly distributed throughout tropical and subtropical regions of the world. It can be found at various natural habitats such as deserts, humid soil, wet rocks, and stream banks of waterfalls and is also found on manmade concrete structures in urban habitats [17, 18].

A variety of invertebrates ranging from small protozoans to larger insects and molluscs inhabits the different groups of moss [16, 19]. Mosses attract invertebrates, primarily due to their water absorption and retention capacity [20]. During dry weather conditions they can completely dry out and stay in a quiescent state till the arrival of favorable conditions [21]. In our study, the number of invertebrate micro faunal species were analysed during 2 different seasons. During both the seasons we were able to observe rotifers, ciliates, nematodes and

miscellaneous eggs of various organisms which is similar to previous reports [14]. However, there were also occurrence of many other protozoans [22] and tardigrades in previous studies [14,22-23]. In our study, we could not observe a single occurrence of tardigrades in any of the samples collected from October-march. During the wet/monsoon period, high number of active animals were observed, which includes ciliates, rotifers and nematodes. At least, two different types of bdelloid rotifer species were identified, and formed the dominant group among the analysed bryofauna. Very few number of eggs and larvae were seen during this season. However, in dry season the samples had relatively higher percentage of eggs, fertilized/cleaving eggs, morula and larvae when compared to metabolically active animals. This could be possibly due to the drier conditions, when the metabolic activity of the animals were low.

5. CONCLUSION

In conclusion, this initial study suggests that the invertebrate communities in mosses are vital component of the ecosystem. As mosses occupy a fairly significant part of the food web, the association between moss and microfauna living amidst them play an important role in majority of the ecosystems. Infact studies have shown mosses can sequester higher carbon than bare soils, retain more nutrients in the soil on which they grow, supports better break down of organic matter and act as biomonitors by being sensitive to any environmental disturbances [24-26] and the microfauna present in the mosses regulate bacterial populations, plays a significant role in nutrient mineralization and plant growth [11-12]. Taking this into account, it is evident that a deeper understanding on the diversity and distribution of moss microfauna is a prerequisite for the use of these organisms in environmental monitoring. In addition, However, such studies are very limited and very little pool of information is available on the same. Therefore, the extent of interaction between invertebrates and mosses needs further investigation to determine whether the bryofauna is just a reflection of the litter fauna of the area in which the mosses are living, or they form integral part of the moss needs further investigation.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Číhal L. Bryophytes in a Changing World: Understanding Distribution Patterns, Risks, and Conservation. *Diversity.* 2023; 15(5): 647.
   Available:https://doi.org/10.3390/d15050647.
2. Gerson U. Bryophytes and invertebrates. In: Smith AJE (ed) Bryophyte ecology, Chapman and Hall, New York. 1982;291–332.
3. Buck WR, Shaw AJ, Goffinet B. Morphology, anatomy, and classification of the Bryophyta. In: Shaw AJ, ed. Bryophyte Biology. Cambridge University Press. 2008;55-138.
4. Ramazzotti G. Il Phylum Tardigrada. Memorie dell'Istituto Italiano di Idrobiologia. 1972;28:1–732.
5. Bahuguna, YM, Gairola S, Semwal DP, Uniyal PL and Bhatt AB. Bryophytes and ecosystem. In: Diversity of Lower Plants (Eds Gupta, R. K. & Kumar, M.). I.K. International Publishing House Pvt. Ltd. 2013;279–296.
6. Gerson U. Moss-arthropod association. The Bryologist. 1969;72:495-500.
7. Anderson LE and Richardson DH. The Biology of Mosses. The Bryologist. 1982;85:274.
8. Gilbert JJ. Dormancy in Rotifers. Transactions of the American Microscopical Society. 1974; 93(4): 490–513.
   Available: https://doi.org/10.2307/3225154.
9. Nicholas WI. The biology of free-living nematodes. Oxford, Clarendon Press. 1975;219.
10. Wright JC. The significance of four xeric parameters in the ecology of terrestrial Tardigrada. Journal of Zoology. 1991;224: 59-77.
11. Gilbert D, Amblard C, Bourdier G. *et al*. The Microbial Loop at the Surface of a Peatland: Structure, Function, and Impact of Nutrient Input. Microbial Ecology. 1998;35:83–93.
    Available:https://doi.org/10.1007/s002489900062.
12. Foissner W. Soil protozoa as bioindicators: pros and cons, methods, diversity, representative examples. Agriculture, Ecosystems and Environment. 1999;74: 95–112.
13. Longton RE. The polar regions. In: Biology of polar bryophytes and lichens. Studies in

Polar Research. Cambridge University Press. 1988;1-31.
14. Merrifield K, Ingham RE. Nematodes and Other Aquatic Invertebrates in *Eurhynchium oreganum* from Mary's Peak, Oregon Coast Range. The Bryologist. 1998;101(4):505–511. https://doi.org/10.2307/3244525.
15. Kinchin IM. The biology of tardigrades. London: Portland Press. 1994;186.
16. Suren MA. Bryophytes and associated invertebrates in first-order alpine streams of Arthur's Pass, New Zealand. New Zealand Journal of Marine and Freshwater Research. 1993;27:479-494.
17. Reese WD, Zander RH, Eckel PM. Genera of the Pottiaceae: Mosses of Harsh Environments. The Bryologist. 1994;97: 216.
18. Deora V and Deora GS. Morphoc taxonomical studies on some mosses of Indian Thar desert. Annals of Plant Sciences. 2017;6:1893-1897.
19. Henrikson B. Sphagnum Mosses as a Microhabitat for Invertebrates in Acidified Lakes and the Colour Adaptation and Substrate Preference in *Leucorrhinia dubia* (Odonata, Anisoptera). Ecography. 1993; 16:143-153.
20. Božanić, B. Thesis on "Terrestrial mosses as living environment for invertebrates". Submitted to the Department of Ecology and Environmental Sciences, Faculty of Science, Palacky University; 2011.
21. Kinchin IM. The moss fauna 3: Arthropods. Journal of Biological Education. 1990;24: 93-99.
22. Šatkauskienė I and Vosyliute R. Microfauna of Moss (Bryophyta: Bryopsida) from Four regions of Lithuania. Acta Zoologica Lituanica. 2010;20(3):225-231.
23. Schuster RK, and Greven H. A long-term study of population dynamics of tardigrades in the moss *Rhytidiadelphus squarrosus* (Hedw.) Warnst. Journal of Limnology. 2007;66:141-151.
24. Eldridge DJ, Guirado E, Reich PB *et al.* The global contribution of soil mosses to ecosystem services. Nature Geoscience. 2023;16:430–438. Available:https://doi.org/10.1038/s41561-023-01170-x
25. Wang S, Zhang Z and Wang Z. Bryophyte communities as biomonitors of environmental factors in the Goujiang karst bauxite, southwestern China. Science of the Total Environment. 2015; 538:270–278.
26. Stefańska-Krzaczek E, Swacha G, Żarnowiec J, Raduła MW, Kącki Z and Staniaszek-Kik M. Central European forest floor bryophytes: Richness, species composition, coexistence and diagnostic significance across environmental gradients of forest habitats. Ecological Indicators. 2022;139: 108954.

© Copyright (2024): Author(s). The licensee is the journal publisher. This is an Open Access article distributed under the terms of the Creative Commons Attribution License (http://creativecommons.org/licenses/by/4.0), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

Peer-review history:
The peer review history for this paper can be accessed here:
https://prh.mbimph.com/review-history/3538