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Study on bryophytes at a local level in relation to environmental variation

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Abstract- The fact that bryophytes are small and barely discernible in comparison to numerous vascular species does not diminish their importance to their ecosystems. Several species of bryophyte, such as those in the genus *Sphagnum*, are ecosystem engineers. It is crucial to comprehend the origins of apparent distribution patterns of organisms in order to successfully manage and conserve biota, replicate past environmental changes, or foresee future changes in species distributions assuming expected environmental changes. Bryophytes could help people live more sustainably as interest in a sustainable future grows, especially in metropolitan areas. In addition to being a less expensive alternative to traditional air quality monitoring approaches, bryophytes paired with green roofs may be more effective over time in monitoring pollution than solely using epiphytic bryophytes. If you reside in the right environment, mosses can be a great alternative to a traditional lawn because they provide habitat for local wildlife while requiring less dangerous upkeep, such as the use of pesticides.

Key words: bryophytes, ecosystem engineers, pesticides, bioindicator

INTRODUCTION

Understanding the links between species and how these relationships may change is crucial for creating successful conservation efforts as climate change and urbanisation affect biodiversity and alter ecosystems. Using empirical niche models to determine vulnerability to climate change has proven to be a highly effective method for estimating the impacts of climate change on biodiversity. To effectively forecast losses and devise conservation strategies, it is vital to consider a species' or population's susceptibility, sensitivity, exposure, and adaptive capacity because the impact of climate changes on biodiversity is a complicated issue.[1] Therefore, in order to possibly lessen the effects of climate change over the next century, especially for understudied populations, it is crucial to do study on species' sensitivities, vulnerabilities, and capacity for adaptation. One understudied category of plants, bryophytes, which includes mosses, liverworts, and hornworts, is anticipated to suffer from climate change and changes in land usage. Poikilohydric (unable to regulate water content independently of their environment), non-vascular, and spore-reproducing, bryophytes are plants that do not have roots or xylem to transport water through their stems.[2]

However, the research on how plants respond to climate change and how land use has changed is significantly biased in favor of vascular plants. Studies on vascular plants cannot be used to anticipate how bryophytes will react to climate change since bryophytes and vascular plants differ in a number of ways, including size and life strategy.[3] Bryophytes may be small and unnoticeable in

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comparison to many vascular species; however this does not mean that they are less significant to their communities than vascular plants. Numerous bryophyte species, including those of the genus *Sphagnum*, are ecosystem engineers (animals that change their surroundings to produce habitat), which can aid in preserving community biodiversity. Additionally, bryophytes offer crucial ecological functions such as changing the availability of nutrients and cycling carbon and water. Humans can directly benefit from bryophytes as well.

Testing hypotheses concerning the effects and causes of biotic interactions, historical variables, actual physiological necessities, and reproductive features of plants must first establish linkages between distribution and abundance and environmental parameters. In order to successfully manage and conserve biota, recreate previous environmental changes, or anticipate future changes in species distributions assuming likely environmental changes, it is important to understand the origins of apparent distribution patterns of organisms.[4] The growing accessibility of geographic information systems for evaluating patterns of environmental elements along with species distributions has helped modeling current species ranges in recent years.

In this paper, we investigate how the species react to these environmental factors, the extent to which species ecological as well as life-history traits correlate to environmental variation and the accuracy of the consistency of species occurrence in order to generate comprehensive lists of species relying on environmental conditions. We use geographic data on species distribution, soil conditions, and land use.

MATERIALS & METHODS

Study Area

The study is done in the Madhepura District, which is between the latitudes of 25°31' and 26°20' and the longitudes of 86°36' and 87°07'. The district's entire 3539 ha of wetland areas, or 2% of its overall geographic area, are made up of over 227 tiny wetlands having a surface area of less than 2.25 hectares. The range of temperatures in the district's highest and lowest points is 35 to 45 degrees Celsius for the former and 7-9 degrees Celsius for the latter. The district receives 1,300 mm^3 of rainfall annually.

For the current study a plot of 20*20 cm was taken from 5 sites in which 2 were from rural area and 3 from urban area. The samples were collected from roofs of dwelling homes, cattle sheds, station building and old schools. The roofing materials of these buildings included cement, stone, steel and thatch. In this area we recorded the bryophyte coverage, including the height of the plot from the ground. Species were identified and labelled properly. The major areas in which Bryophytes have shown their role includes water cycling, carbon cycling, nutrient cycling and maintenance of community level biodiversity.

Multi Response Permutation Procedure (MRPP) was used to estimate species difference in different roofs. Cluster Analysis was used for indicator species. Different species and their number was calculated and presented. (table 1)

Table 1 -List of Species found from 2 rural as well as 3 city sites

Species found	Rural 1.	Rural 2.	City 1	City 2	City 3	total
1. *Bazzania tridens*	2	3	1	0	1	7
2. *Chiloscyphus latifolius*	1	2	0	2	3	8
3. *Chiloscyphus profundus*	0	1	2	0	1	4
4. *Heteroscyphus zolliingeri*	2	3	1	1	3	10
5. *Kurzia gonyotricha*	3	2	2	2	1	10
6. *Campylopus atrovirens*	2	1	1	0	0	4
7. *Ectropothecium dealbatum*	3	3	1	2	2	11
8. *Entodon schleicheri*	2	3	1	1	0	7
9. *Fauriella tenuis*	5	0	0	0	0	5
10. *Fissidens laxus*	3	2	0	0	0	5
11. *Haplocladium microphyllum*	3	1	1	1	1	7
12. *Homalia trichomanoides*	2	2	1	1	0	6
13. *Plagiomnium rhynchophorum*	3	1	2	0	0	7
14. *Thuidium pristocalyx*	0	0	6	0	1	7

RESULTS & DISCUSSION

The total number of Bryophytes collected and identified were 14. From the above observation we see that the occurrence of various Bryophytes vary according to place and the level of pollution. Number of most Bryophytes decreases in cities as compared to its rural counterparts.

The species *Fauriella tenuis* is exclusive as it is found only in the area of Rural 1.

Ectropothecium dealbatum has most number of species and is also diverse as it is spread almost equally in rural and city areas.

Fissidens laxus is exclusive to rural areas as its growth was not seen in any of the city area.

Carbon Cycling:- As carbon from the atmosphere flows to reservoirs like the ocean, organisms, soil, and rocks, carbon cycling takes place. Bryophytes, like vascular plants, have an impact on this cycle through their development and metabolic activities like photosynthesis and respiration (As carbon from the atmosphere flows to reservoirs like the ocean, organisms, soil, and rocks, carbon cycling takes place.[5] Bryophytes, like vascular plants, have an impact on this cycle through their development and metabolic activities like photosynthesis and respiration.

Water Cycling:- Bryophytes change the water cycle in their community by acting as a temporary water storage area due to their poikilohydric nature.[6] Yet, the way that bryophytes intercept rainfall has the biggest effect on the water cycle.

Nutrient Cycling :- Nitrates must be accessible for plants and other species to use in order for an ecosystem to function effectively. For instance, fixation or mineralization is required to make elements like nitrogen and phosphorus accessible.[7]

Community Biodiversity:- A varied range of species are required to perform essential ecosystem services in order to have a healthy ecosystem. The term "biodiversity" refers to the variety of living things in an ecosystem. It can quantify genetic diversity within and between species at various scales, such as communities, ecosystems, or even the entire planet. Many different creatures have habitats in bryophytes.[8] Bryophytes are frequently home to micro- and macro-invertebrates, including nematodes, rotifers, and chironomidae, ranging from species that only inhabit bryophytes to those that associate with them but do not depend on them for survival.

CONCLUSION

Humans can use bryophytes for a variety of purposes, and they contribute significantly to the health of communities' ecosystems. Bryophytes may aid people in living more sustainably, particularly in urban settings, as interest in a sustainable future develops. Because to its desiccation resistance, bryophytes make a better substate choice for locations that occasionally encounter arid weather and can assist alleviate issues like the urban heat island effect when used as a substrate for green roofs. Bryophyte can be utilised as a bioindicator in metropolitan settings with high levels of pollution. Bryophytes combined with green roofs may be more effective at monitoring pollution over time than only utilising epiphytic bryophytes, in addition to being a less expensive alternative to conventional air quality monitoring techniques. Mosses may be an excellent substitute for a standard lawn for those who live in the correct climate because they offer habitat for local fauna while requiring less hazardous maintenance, such as the use of pesticides. The wide variety of secondary chemicals produced by bryophytes must also be identified, as well as the biological activity they display. Interest in bryophytes' conservation and application in sustainable urban contexts may grow as more research on them is conducted and people become aware of their advantages.

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