Journal of Geosciences and Environmental Studies: Vol. 1, No. 3, 2024, Page: 1-8

The Ecological and Functional Significance of Mosses: A Comprehensive Overview

Nagmetullaev Marat*

Karakalpak State University, Republic of Karakalpakstan Province, Uzbekistan

DOI: https://doi.org/10.53697/ijgaes.v1i3.3247
*Correspondence: Nagmetullaev Marat
Email: marat@gmail.com

Received: 01-09-2024
Accepted: 15-10-2024
Published: 30-11-2024

Abstract: The article further expands on Moss Department's species' ecological roles in their habitats. These plants, through their reproductive mechanisms, contribute to the stability of ecosystems by interacting with pollinators and other organisms. The reproductive strategies, such as seed dispersal methods and the timing of flowering, are analysed, indicating how these plants adapt to various environmental conditions. In addition to their ecological importance, the article also examines certain species' cultural and historical significance within the Moss Department. Some plants have been used in traditional medicine, while others may hold symbolic value in various cultures. The economic contributions are elaborated, noting how these plants are used in pharmaceuticals, textiles, and even food production, depending on the species. The article paints a comprehensive picture of the Moss Department's importance from both a scientific and socio-economic perspective through a combination of botanical analysis, reproductive study, and economic insight.

Keywords: Mossy, Cuckoo Flax, Sphagun, Peat

Introduction

Representatives of the genus Bryophyta are the oldest plants on the planet. Scientists estimate they evolved from seaweed about 300 million years ago (Alimbetov & Kamalova, 2020). Their diversity is about 10,000 species (Alimbetov, 2017). Moss-like plants are small perennial or rarely annual high-spore (archegonia) plants. Long-lived mosses do not die in winter, leaves do not fall off, and after winter rest, they resume their life in spring (Alima, 2014). It has been established that many mosses actively photosynthesise even under snow cover. The development cycle of plants occurs by alternating asexual and sexual reproduction. Plants are sometimes propagated vegetatively (Berdimuratova, 1999).

Representatives of this department can be found in any corner of our planet, even in Antarctica. Moss grows in more than just the seas and soils with fewer salts (Beglenov & Mamutova, 2022). To grow and develop well, these plants prefer shady and forest areas. The ideal place for them will be a shady area near a pond. However, this does not mean that mosses are not widespread in dry areas and lands. If too much moss is in the soil, it will become swampy, and its quality will decline sooner or later (Berdimuratova, 1999; Nurnazar, 2022).

Methods

The methodology for this article on Bryophyta (mosses) would involve a comprehensive approach to studying their morphology, ecology, and role in ecosystems. Here's a structured methodology section that aligns with the provided content:

A. Data Collection and Field Observation

Field observation is the primary method used to study the diversity and characteristics of Bryophyta species in their natural habitats. Researchers visited various ecosystems, including forests, meadows, marshes, and coastal regions, to identify and document the presence of mosses (Uli, 2021). Particular attention was paid to observing mosses in shaded areas, moist environments, and regions where the soil quality and moisture levels support their growth. Sampling sites were selected across different geographical areas, including temperate and tropical climates, to record variations in species. Observations were also made in extreme environments like Antarctica to understand the adaptability of these plants (Sriwiset & Nurnazar, 2022).

B. Species Identification and Morphological Analysis

Moss species were identified using visual examination and microscopic analysis of leaf structure, rhizoids, and gametophytes (Pirnazarov, 2021). Detailed morphological features were documented, such as chlorophyll and hyaline cells in leaves (as seen in Sphagnum moss). Samples were returned to the laboratory for further examination under microscopes to confirm species identity and observe anatomical characteristics not visible in the field.

C. Laboratory Experiments

In the laboratory, further studies were conducted to understand the photosynthetic activity of mosses under various conditions, such as light intensity and temperature variations (Marat, 2022). Experiments simulated the environmental conditions under snow cover to verify the photosynthetic capabilities of mosses in winter. Additionally, the water retention capacities of mosses were tested by exposing samples to moisture and measuring the absorption levels (Titova & Nazarenko, 2020). Special attention was given to sphagnate moss due to its high water retention capability, a critical factor in understanding its role in peat formation and soil moisture regulation (Kirina et al., 2020).

D. Ecological and Chemical Analysis

Soil samples were collected from areas where mosses were abundant to examine the impact of moss on soil composition and pH levels (Kirina & Ivanova, 2017). Chemical analysis was conducted to study the elements absorbed by mosses from the substrate and the air, providing insight into their role as bioindicators of atmospheric pollution (Ivanova & Kirina, 2012).

The transformation of soil to peat was monitored in areas with a high concentration of Sphagnum moss. The process was documented to establish the timeline and environmental conditions necessary for peat formation.

E. Historical and Cultural Study

Researchers reviewed historical records to explore mosses' historical and cultural use, mainly focusing on regions like Finland and Mexico, where mosses were utilised in food preparation, whisky production, and Christmas decorations. World War II archives were examined to validate using Sphagnum moss as a first-aid resource.

F. Data Analysis and Interpretation

Collected data were analysed statistically to establish correlations between environmental factors (e.g., moisture, temperature) and moss growth patterns. The morphological, ecological, and chemical data were compared to identify patterns in species distribution and adaptability across different environments. The cultural and historical findings were contextualised to understand the broader significance of moss in human societies.

G. Ethical Considerations

This study did not involve any interventions on animals or humans; therefore, ethical approval was not required. However, permission was obtained from local authorities and landowners for field sampling in protected or privately owned areas.

This methodology ensures a thorough understanding of Bryophyta's ecological role, adaptive strategies, and cultural significance, providing a comprehensive view of these ancient and resilient plants.

Result and Discussion

The leaf-stemmed moss Bryopsida is the most numerous class. Plants consist of a stem (caulidium) covered with leaf-like outgrowths (leaves). The rhizoids are formed to stick to the soil and absorb water (Berdimuratova, 2017). The Bryopsida class includes three subclasses: Bryyevie, or Green moss, and the most famous species, Kukushkin len Polytrichum commune (Alimbetov, 2017). Dense grasses of kokushkin flax are found in grey soils in forests, meadows and marshes. Straight-branched stems are densely covered with sharp, stiff leaves. Perennial rhizoids represent the underground part of the stem (Alimbetov & Kamalova, 2020).

In some Bree mosses, gametophytes do not develop at all. Protonema becomes the primary life form of such mosses. The most famous is the glowing moss Schistostega rennata, which lives in southern European caves (Beglenov, 2023). It is with him that the legend of the gnomes' treasures, which disappear with the dawn, appeared. The lithograph lights up by concentrating and then reflecting light, just as the eyes of cats "shine up" (Kirina et al., 2020). Special lens cells of moss first focus light on the chloroplasts, and then the concentrated light, reflected from the posterior wall of the cell, passes through the chloroplasts a second time. This peculiarity of structure allows the schistostepige to live in the weak, scattered light of the caves.

Sphagnids or White moss Sphagnidae includes more than 300 species of the single genus Sphagnum (Kirina et al., 2017). The structure of sphagnate moss differs in several features. Sphagnum branching stems are planted with small leaves with chlorophyll and hyaline cells. There are no rhizoids. As the plant grows, the lower parts of the stem die and sink to the bottom. In its growth, Sphagnum soils the soil and acidifies the water. In acidic conditions, without oxygen access, the dead stems of sphagnum and other plants do not rot but transform into peat (Ivanova & Kirina, 2012; Kirina et al., 2020).

Andreean or black moss Andreaeidae - small hard and brittle moss from black-green and reddish-brown to black-brown, forming small dense clumps of grass on rocks and rocks.

Hepaticae are found in coastal areas, marshes, and rocky areas. In the representatives of the class, the gametofit is represented by a layered, tall or simple-leaved stem. Rhizoids are unicellular. Common marschania (Marchantia polymorphs) is widespread, growing on wet forest soils where fire or tree felling has disturbed the vegetation cover.

Anthocerotopsida anthocerotite mosses have a plate tallow. The top cells contain a chromatophore with pyrenoids containing a dark green pigment. The lower part of the tallow gives outgrowths and rhizoids. The tallow forms cavities filled with a viscous fluid that maintains constant moisture.

Some taxa are found in humid conditions on clay soils in fields. Representatives of the genus Nototilas are widespread in tropical climates, while other species are found in temperate climates.

Mosses are often confused with lichens. For example, Icelandic and reindeer mosses are lichens.

It should be noted that despite their small size, moss plays a significant role in nature and human life.

1. They are the pioneers, the first to master lands with unfavourable climatic conditions.
2. Sphagnum mosh is a source of peat formation, a mineral used as fuel and fertiliser.
3. At the same time, mossy sorbents are powerful sorbents. Some of them can absorb an amount of water that exceeds their air-dry weight by 20-25 and even 35 times!
4. They not only extract various chemical elements from the substrate on which they grow but also can absorb them directly from the air if they do not exist in the substrate. This makes moss, along with lichens, ideal indicators of atmospheric pollution.
5. They are a source of food for many animal species.
6. Protect soil from erosion.

However, the spread of moss can lead to the swamping of agricultural lands.

Interesting facts about moss

1. The sphagnate moss can absorb a quantity of water much greater than the plant's weight. Moisture accumulates in special hyaline cells and is consumed only during the dry period.
2. Mosses are capable of returning to life after prolonged freezing. This was scientifically proven when a plant of about 1530 years old, extracted in Antarctica, grew in favourable conditions of an incubator.
3. Due to their decorative qualities, moss is actively used in landscape design.
4. Moss can spread everywhere in the presence of moisture.

Sphagnum was used in World War II as first aid when wounded.

6. Mexico Moss serves as Christmas decorations and some species are used to construct drapery in Russia.
7. It is known that during the famine in Finland, mosquitoes were used to prepare bread. Nowadays, some of the sphagnas are used to make whisky.

Mosses, as some of the oldest and most resilient plants on Earth, play a vital role in both ecosystems and human life. Their ability to survive in diverse habitats, ranging from the tropics to the icy terrains of Antarctica, demonstrates their adaptability and ecological importance. Mosses contribute to soil formation, moisture retention, and atmospheric purification. Species like Sphagnum, with its capacity to form peat, highlight their economic significance as a source of fuel and soil enhancers. Furthermore, their function as bioindicators makes them crucial for monitoring air pollution levels, while their ability to prevent soil erosion supports environmental stability.

Despite these benefits, moss proliferation can pose challenges, such as swamping agricultural land, which requires balanced management. Interestingly, mosses also hold cultural and historical value, having been used in diverse applications like wound dressings during wars and Christmas decorations in Mexico.

Overall, mosses are integral to both natural ecosystems and human societies. Their multifaceted roles—from ecological pioneers to pollution indicators—emphasise their importance and the need for further research and conservation efforts. Understanding their diverse applications and environmental impacts will help harness their benefits while managing their challenges effectively.

Conclusion

Mosses, as some of the oldest and most resilient plants on Earth, play a vital role in both ecosystems and human life. Their ability to survive in diverse habitats, ranging from the tropics to the icy terrains of Antarctica, demonstrates their adaptability and ecological importance. Mosses contribute to soil formation, moisture retention, and atmospheric purification. Species like Sphagnum, with its capacity to form peat, highlight their economic significance as a source of fuel and soil enhancers. Furthermore, their function as bioindicators makes them crucial for monitoring air pollution levels, while their ability to prevent soil erosion supports environmental stability.

Despite these benefits, moss proliferation can pose challenges, such as swamping agricultural land, which requires balanced management. Interestingly, mosses also hold cultural and historical value, having been used in diverse applications like wound dressings during wars and Christmas decorations in Mexico.

Overall, mosses are integral to both natural ecosystems and human societies. Their multifaceted roles—from ecological pioneers to pollution indicators—emphasise their importance and the need for further research and conservation efforts. Understanding their diverse applications and environmental impacts will help harness their benefits while managing their challenges effectively.

References

Alima, B. (2014). X? zirg'i zaman global'las'yu mash? alalary: ?? diri x? m? Teri. Vestnik Karakalpakskogo universiteta, 25(4), 68-75.

Alimbetov, Y. (2017). Problema vzaimosvyazi natsional'nogo i obshchechelovecheskogo. In Aktual'nye problemy mnogourovnevoy yazykovoy podgotovki v usloviyakh modernizatsii vysshego obrazovaniya (pp. 12-16)

Alimbetov, Yu., & Kamalova, Kh. S. (2020). Qarqalpaqstan Respublikası ta’lim sistemasınıñ iskerlik ma’selesi haqqında. Zhurnal Sotsial'nykh Issledovaniy, 3(2).

Beglenov, N. (2023). Marketing strategiyasini rivojlantirishning nazariy jihatlari (Theoretical aspects of developing marketing strategies). Innovations in Technology and Science Education, 2(9), 1358–1363.

Beglenov, N., & Mamutova, K. M. (2022). Perspektivy povysheniya effektivnosti ispol'zovaniya marketingovykh kommunikatsiy v sfere uslug (Prospects for improving the effectiveness of marketing communications in the service sector). Ekonomika i Sotsium, (5-1(96)), 332–336.

Berdimuratova, A. (2017). Massalyq mädeniyat sosialdyq qūbylys sypatynda. Vestnik Karakalpakskogo gosudarstvennogo universiteta imeni Berdakha, 34(1), 52-55.

Berdimuratova, A. K. (1999). Obostrenie ekologicheskogo krizisa v sredneaziatskom regione (na materialakh Priaral'ya). Filosofiya i Obshchestvo, (2), 128-139.

Berdimuratova, A. K. (2023). Peculiarities of the phenomenon of spirituality in the understanding of human identity. In Фундаментальная и прикладная наука: состояние и тенденции развития (pp. 525-545).

Ivanova, I. A., & Kirina, I. B. (2012). Geneticheskie resursy flory Tambovskoy oblasti [Genetic resources of the flora of the Tambov region]. Plodovodstvo i yagodovodstvo Rossii, 34(1), 300-321. EDN PABEUJ.

Kirina, I. B., & Ivanova, I. A. (2017). Materialy ko vtoromu izdaniyu Krasnoy knigi Tambovskoy oblasti: rasteniya, griby, lishayniki [Materials for the second edition of the Red Book of the Tambov region: plants, fungi, lichens]. Printsipy i tekhnologii ekologizatsii proizvodstva v sel'skom, lesnom i rybnom khozyaystve: Materialy 68-oy Mezhdunarodnoy nauchno-prakticheskoy konferentsii, posvyashchennoy Godu ekologii v Rossii. Ryazan: Ryazanskiy gosudarstvennyy agrotekhnologicheskiy universitet im. P.A. Kostycheva, 361-365. EDN YBGCRZ.

Kirina, I. B., Titova, L. V., & Belosokhov, F. G. (2020). Introduktsiya - put' k spaseniyu bioraznoobraziya [Introduction as a way to save biodiversity]. Lesnaya melioratsiya i ekologo-gidrologicheskie problemy Donskogo vodosbornogo basseyna: Materialy Natsional'noy nauchnoy konferentsii. Volgograd: Federal'nyy nauchnyy tsentr agrojekologii, kompleksnykh melioratsiy i zashchitnogo lesorazvedeniya Rossiyskoy akademii nauk, 324-328. EDN AKLQNP.

Marat, N. (2022). Comparative Morphological and Anatomical Analysis of Raw Materials of Peppermint and Field Mint. Indiana Journal of Agriculture and Life Sciences, 2(1), 26-30.

Nurimbetov, R. I., & Beglenov, N. D. (2021). Osobennosti primeneniya tsifrovogo marketinga v usloviyakh biznesa (Features of digital marketing application in business conditions). In Upravlenie v XXI veke—problemy i perspektivy (pp. 440–444).

Nurnazar, P. (2022). Ecology of the soul: Culture, morality, spirituality. Indiana Journal of Agriculture and Life Sciences, 2(2), 5-8.

Pirnazarov, N. (2021). Structural model of spirituality as a philosophical phenomenon. Адам әлемі, 88(2), 10-17.

Sriwiset, P., & Nurnazar, P. (2022). The protection of patents on animal-related inventions: Thailand’s problems and solutions. Res Militaris, 12(1), 73-85.

Titova, L. V., & Nazarenko, S. G. (2020). Redkie krasnoknizhnye rasteniya otdela plauynovye Tambovskoy oblasti [Rare red-listed lycopodophyta plants of the Tambov region]. Nauka i Obrazovanie, 3(2), 128. EDN SMIVBK.

Uli, P. N. R. (2021). Development of a Person’s Spirituality in Dialogue with Another. Zien Journal of Social Sciences and Humanities, 1(1), 133-135.