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Sustaining the Green Tapestry: Qualitative Insights into Bryophyte Conservation in Mindanao, Philippines

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ABSTRACT

Bryophytes, including mosses, liverworts, and hornworts, are vital to terrestrial ecosystems in Mindanao, Philippines, contributing to ecological resilience through microclimate regulation, soil moisture retention, and supporting diverse faunal communities. This qualitative study explores the social, cultural, and ecological dimensions of bryophyte conservation in Mindanao, highlighting the challenges and opportunities for preserving these essential organisms. Using in-depth interviews, focus group discussions, and field observations, the research engages key stakeholders—local communities, governmental bodies, and academic institutions—to uncover the complexities of bryophyte conservation. Thematic analysis identifies six emergent themes: Local Ecological Knowledge, Threats to Bryophyte Habitats, Community Perspectives on Conservation, Institutional Support and Funding Constraints, Role of Collaborative Partnerships, and Participatory Governance and Environmental Stewardship. Findings reveal rich ethnoecological knowledge among local communities but also significant threats from urbanization, agriculture, and extractive activities. The study underscores the need for collaborative, community-driven conservation initiatives to integrate traditional knowledge with scientific expertise, ensuring the sustainable preservation of bryophyte diversity in Mindanao.

Keywords: Bryophyte conservation, Mindanao, Qualitative research, Community-driven initiatives, biodiversity

INTRODUCTION

Bryophytes, comprising mosses, liverworts, and hornworts, constitute a vital component of terrestrial ecosystems worldwide. In Mindanao, these cryptic plants contribute to the region's ecological resilience by regulating microclimates, retaining soil moisture, and supporting diverse faunal communities. Generally, bryophytes exhibit broader spatial coverage or occupancy, known as range, in comparison to vascular plants. However, as haploid organisms with high specialization, they are typically attached to microhabitats and are sensitive to even slight environmental fluctuations (Sabovljevic et al., 2022). Despite their ecological significance, bryophytes face numerous threats, including habitat loss, land-use conversion, and unsustainable harvesting practices. This study aimed to explore the social, cultural, and ecological dimensions of bryophyte conservation in Mindanao, shedding light on the challenges and opportunities for sustaining these invaluable organisms.

Utilizing a blend of in-depth interviews, focus group discussions, and field observations, this study navigates the cultural, economic, and ecological dimensions of bryophyte conservation. By engaging key stakeholders ranging from local communities to governmental bodies and academic institutions, the research seeks to unravel the complexities inherent in safeguarding Mindanao's bryophyte diversity and the ecosystems they inhabit. Through thematic analysis, the study uncovers emergent themes that underscore the urgent need for collaborative, community-driven initiatives to preserve the verdant legacy of Mindanao's green tapestry.

Nestled within the verdant embrace of Mindanao, the southernmost bastion of the Philippines, lies a treasure trove of biodiversity that encompasses a rich array of bryophytes. These often-overlooked organisms, including mosses and liverworts, contribute significantly to the region's ecological integrity, serving as indicators of environmental health and playing crucial roles in nutrient cycling and habitat provision. Despite their ecological importance, bryophytes remain overshadowed in the realm of conservation efforts, with their conservation needs often relegated to the periphery of environmental agendas.

OBJECTIVES OF THE STUDY

This study aimed to investigate the social, cultural, and ecological dimensions of bryophyte conservation in Mindanao and develop strategies for sustainable preservation through community engagement and collaborative partnerships.

METHODOLOGY

Research Design

The study utilized a qualitative research approach, aiming to provide in-depth insights into the economic, cultural and ecological dimensions of bryophyte conservation. Qualitative research is chosen to allow for a nuanced understanding of the topic and to explore subjective experiences and perspectives.

Participants of the Study

The target participants encompassed a spectrum of stakeholders deeply involved in bryophyte conservation, including: local communities, community leaders, and practitioners possessing rich traditional ecological knowledge about bryophyte habitats, uses, and conservation practices.

Research Locale

The research locale where the study was conducted is in selected areas in Mindanao, including Bukidnon, Davao, and Misamis Oriental.

Sampling Procedure

For this qualitative research on bryophyte conservation in Mindanao, purposive sampling was employed. Purposive sampling, also known as judgmental or selective sampling, involves deliberately selecting participants or cases based on specific criteria relevant to the research objectives. Patton (2015) characterizes purposeful sampling as the deliberate and strategic choice of individuals, groups, or cases, guided by criteria that align with the research objectives.

Purposeful sampling stands out as the predominant method in qualitative research, allowing researchers to select individuals possessing comprehensive insights into the phenomena under investigation (Creswell & Poth, 2018; Campbell et al., 2020). Criterion sampling, a type of purposeful sampling, holds particular relevance in phenomenological research, ensuring that each participant has directly encountered the phenomena in question. Thematic analysis was

applied to identify recurring patterns, emergent themes, and nuanced insights related to bryophyte conservation practices and perceptions.

Research Instrument

The researcher conducted in-depth interviews with key stakeholders involved in bryophyte conservation efforts across Mindanao. These interviews likely followed a semi-structured format, allowing for flexibility while ensuring key topics are covered. Also, focus group discussions were organized to gather insights from different perspectives simultaneously, fostering interaction and generating rich discussions among participants. Additionally, Field observations were conducted to complement the interview and discussion data, providing researchers with firsthand experiences and contextual understanding of bryophyte habitats and conservation practices.

Thematic Qualitative Data Analysis

Six emergent themes were identified, namely: (1) Local Ecological Knowledge, (2) Threats to Bryophyte Habitats, (3) Community Perspectives on Conservation, (4) Institutional Support and Funding Constraints (5) Role of Collaborative Partnerships, and (6) Participatory Governance and Environmental Stewardship.

RESULTS AND DISCUSSION

The findings revealed a multifaceted landscape of bryophyte conservation in Mindanao, characterized by a blend of traditional knowledge, contemporary conservation initiatives, and emerging challenges. Local communities, deeply connected to their natural surroundings, possess rich ethnoecological knowledge about bryophyte habitats, uses, and conservation practices. However, rapid urbanization, agricultural expansion, and extractive activities pose significant threats to bryophyte-rich ecosystems, exacerbating biodiversity loss and ecological degradation. Despite growing awareness of bryophyte conservation among local stakeholders, limited institutional support, funding constraints, and insufficient scientific research impede effective conservation action.

Focus Group Discussion of the Six Themes

Theme 1: Local Ecological Knowledge

This theme refers to the Local communities have a profound understanding of bryophyte habitats, their uses, and conservation practices. This knowledge is not just superficial but deeply ingrained in their culture and traditions. Elders and community leaders play a crucial role in transmitting traditional knowledge about bryophytes across generations. This passing down of knowledge ensures its continuity and preservation. In the Pacific Northwest, there is interest in learning more about traditional ecological knowledge and how it can be integrated into forest biodiversity conservation (Nelson et al.2006). Despite support for the concept, applying the ecological knowledge of local people to biodiversity conservation is not easy (Charnley et al. 2007).

There are various aspects of bryophyte conservation and community involvement, including local ecological knowledge, threats to habitat, community perspectives on the conservation, support and funding constraints collaborative partnerships and participatory governance an environmental stewardship. Each theme provides insights into the challenges and opportunities for protecting bryophytes habitats and involving local communities in conservation efforts. Some traditional understandings are common knowledge, shared by all members of a tribal community, ethnic group, kin network, or family. Many of these are learned through phenomenological experience and everyday activities (Bruchac, 2014).

Data showed that local communities reveal deep-rooted ethnoecological knowledge about bryophyte habitats, uses, and conservation practices. Elders and community leaders possess traditional knowledge passed down through generations, including the medicinal properties of certain bryophyte species and their role in local rituals and ceremonies. emphasize the importance of local knowledge in bryophyte conservation and highlight the need for its integration into modern conservation practices. These understandings and relations constitute a system broadly identified as traditional knowledge or aboriginal knowledge (Bruchac, 2022).

Local Question:

Unsay mga tradisyunal nga kahibalo o pamaagi bahin sa mga lumot nga gipasa-pasa sa mga kahenerasyon sa inyong komunidad? (Could you share any traditional knowledge or practices regarding bryophytes that have been passed

down through generations in your community?)

"Oo, sa among katigulangan, gitun-an nila kanunay ang kahalangdon sa mga lumot ug unsay ilang mga gamit ug kahalangdon sa atong kalikupan. Bisan pa man sa karon, atong gihalad ang tradisyunal nga pag-ampo ug pagsalig sa mga lumot aron maampuhan ug mahaluan kita sa tanang butang nga atong ginahimo." (**Yes, in our ancestors' time, they always studied the importance of bryophytes and their uses and significance in our environment. Even now, we continue to offer traditional prayers and trust in bryophytes to bless and enrich us in all our endeavor**s). [Participant 1]

Ang lumot gihimo namo syang usa ka tambal kung magsakit ang tiyan. Kini ginahimo namong hampol tungod kai nahimo namo ning tradisyon sukad pa sauna sa amoang mgga katigulangan. Kini ilaha gi share ug napadayun namo hantod karon. (**We turn the moss into a remedy when the stomach aches. We use it as a poultice because we've made this a tradition since our ancestors' time. They shared this knowledge with us, and we have continued it until now.**). [Participant 3]

Until now, they continue to share the traditional knowledge that has been passed down through generations. Participant 1 and 3 immediately responded and shared their ancestral wisdom with others. They feel validated and respected for their cultural heritage and the valuable insights they possess about bryophyte ecology. Additionally, by expressing their ongoing connection to bryophytes through traditional prayers and beliefs and also use as medicine, they may feel a deep spiritual connection to their environment and a commitment to its preservation. This underscores the importance of cultural traditions in environmental stewardship and the symbiotic relationship between local knowledge and ecological conservation efforts

Theme 2: Threats to Bryophyte Habitats

This theme emphasizes the urgent need to address the various anthropogenic threats facing bryophyte habitats in Mindanao and underscores the importance of data-driven conservation efforts to safeguard these vulnerable ecosystems. Field observations and interviews with environmental activists and researchers highlight the growing threats to bryophyte-rich ecosystems in Mindanao. Rapid urbanization, agricultural expansion, and extractive activities such as mining and logging are identified as major drivers of habitat loss and degradation.

Predicting extinction risk in the current context of environmental change is critical for species conservation, as it involves identifying drivers such as biological features and habitat specialization. Nevertheless, there aren't enough thorough research on vulnerable bryophytes that contrast them with non-threatened ones Calleja et al. (2022).

Local Question:

Unsa imong panan-aw sa mga katalagman nga ginaatubang sa mga panimalay sa mga lumot sa inyong lugar, sama sa urbanisasyon ug mga aktibidad sa pagkuha og yuta? (How do you perceive the threats facing bryophyte habitats in your area, such as urbanization and extractive activities?)

"Panan-aw nako, ang labing dako nga katalagman sa mga lumot dinhi mao ang paglambo sa syudad ug ang mga aktibidad nga naga-apod-apod sa atong yuta. Kini makadaot sa kinaiyahan ug makasamad sa natural nga kinaiya sa mga lumot. Mahimo kini magdala og pagka-upaw sa ilang habitat ug magpababa sa ilang populasyon". (**In my view, the biggest threats to bryophyte habitats here are urbanization and land acquisition activities. These can harm the environment and disrupt the natural balance of bryophytes. They may cause habitat destruction and decrease their population**). [Participant 2]

"Sa ako lang nga opinion ang mga lumot ron kai apektado tungod kai nagkadaiya ang mga aktibidad sa gobyerno nga nakaguba gyd sa habitat sa lumot aron lang mapatukod ang mga building o mga dalan." (**In my opinion, the moss is currently affected because government activities have caused damage to the moss habitat in order to build buildings or roads.**) [Participant 3]

The threats to bryophyte habitats such as urbanization and land acquisition activities, participant 2 and 3 feel a sense of concern and urgency about the impact of these developments on their environment and cultural heritage. They may also feel a deep connection to the land and a responsibility to protect it for future generations. Additionally, they also feel frustrated or saddened by the potential loss of biodiversity and traditional knowledge associated with bryophytes. Moreover, Participant 2 and 3 highlighted the biggest threats to bryophyte habitats and activities that also affect them.

Urban expansion leads to habitat fragmentation and degradation, resulting in the loss of suitable habitats for bryophytes. The conversion of natural landscapes

into urban areas disrupts ecological processes, such as water retention and nutrient cycling, which are vital for bryophyte survival. Additionally, urban environments often have higher pollution levels and altered microclimates, further impacting bryophyte populations. Urbanization has been accelerating around the world during the past several decades becoming an increasingly important cause of habitat loss and fragmentation (Liu et al. 2018).

Land acquisition activities, such as deforestation, mining, and agricultural expansion, contribute to habitat loss and degradation. These extractive activities often involve the clearing of vegetation, including bryophyte-rich habitats, to make way for infrastructure development or resource extraction. The main proximate causes of deforestation are agricultural expansion, infrastructure development and logging (Geist & Lambin, 2002). Limiting illegal logging could protects forest habitats, since 40-61% of timber production in Indonesia and 70% of the harvested timber in Gabon is believed to stem from illegal logging (Lawson, 2010).

Theme 3: Community Perspectives on Conservation

This theme underscores the importance of integrating community perspectives and engagement into conservation initiatives to achieve meaningful and sustainable outcomes while respecting local cultures and livelihoods. Engaging with communities and developing conservation programs based on their preferences, needs, and aspirations is seen as more ethical and democratic, leading to more effective and sustainable conservation outcomes.

Focus group discussions with local communities reveal diverse perspectives on bryophyte conservation. While some express concern about the loss of traditional knowledge and ecological heritage, others emphasize the need for economic development and job opportunities. It explores community attitudes and perceptions toward conservation initiatives, highlighting the importance of cultural sensitivity and community engagement in fostering sustainable conservation practices.

Local people's nearness, motivation, knowledge and activities make them key partners in conservation programs. Developing such programs based on local preferences, needs and aspirations offers a more ethical and democratic means to achieve conservation outcomes, while maintaining local livelihoods. Conflicts and associated long-term costs will then be reduced and conservation programs more effective and sustainable Heist et al. (2015).

Local Question:

Unsa ang mga pangunahing mga alalahanin o prayoridad sa inyong komunidad bahin sa pagpanalipod sa mga lumot?(What are the main concerns or priorities of your community regarding bryophyte conservation?)

"Ang pangunahing alalahanin sa among komunidad bahin sa pagpanalipod sa mga lumot mao ang pagpreserba sa ilang kahalangdon alang sa kinabag-ohan ug sa kaugmaon. Gusto namo nga matigayon ang hinayhay ug ang mga serbisyo nga gihatag sa mga lumot alang sa atong panginahanglan sa ekolohiya ug kahayag sa among kaugalingon ug sa masunod nga henerasyon." (**The main concern in our community regarding bryophyte conservation is the preservation of their significance for the present and future generations. We aim to maintain the balance and the services provided by bryophytes for our ecological needs and the well-being of our community and the succeeding generations**). [Participant 5]

"Diri lang sa among lugar kahibalo man gyd mi nga maggamit namo ang lumot maong among concern lang is dili sya pang gub-on ug e overharvest kai sa amo lang na tradisyon gamit gyd kaayu sya." (**Here in our area, we are well aware of how to use the moss, so our concern is simply not to destroy or overharvest it because, in our tradition, it's very important**). [Participant 7]

After discussing their community's perspectives on bryophyte conservation, local people may feel a strong sense of responsibility and commitment to preserving the ecological balance and cultural significance of bryophytes for current and future generations. They may also feel hopeful about the potential for positive change and the opportunity to work together to achieve their conservation goals. Additionally, they may feel empowered by the recognition of their community's priorities and the importance of their traditional knowledge.

Community perspectives serve as valuable guiding principles for designing inclusive and effective bryophyte conservation strategies. By incorporating local knowledge, values, and priorities into conservation planning, stakeholders can enhance community engagement, build trust, and foster collaborative partnerships for achieving shared conservation goals.

The perception of inadequate support from government agencies and other organizations for bryophyte conservation efforts underscores the challenges faced in implementing effective conservation measures in the local context. This

observation highlights the need for enhanced commitment, resource allocation, and regulatory enforcement to address the pressing issues confronting bryophyte habitats.

Theme 4: Institutional Support and Funding Constraints

This theme viewed as the importance of addressing institutional support and funding constraints to strengthen conservation efforts for bryophytes in Mindanao. Overcoming these challenges is essential for effectively protecting and preserving bryophyte habitats in the region. Interviews with representatives from government agencies and conservation organizations reveal challenges related to limited institutional support and funding constraints for bryophyte conservation projects. Bureaucratic hurdles, competing development priorities, and lack of political will are cited as barriers to effective conservation action.

Local Question:

Unsa imong pagtamod sa suporta gikan sa mga ahensya sa gobyerno ug uban pang mga organisasyon alang sa mga paningkamot sa pagpanalipod sa mga lumot sa inyong lugar? (How do you perceive the support from government agencies and other organizations for bryophyte conservation efforts in your area?)

"Ako, sa akong bahin, nakita nga ang suporta gikan sa mga ahensya sa gobyerno ug uban pang organisasyon alang sa pagpanalipod sa mga lumot dili kaayo saktong malig-on. Bisan pa, aduna'y mga proyekto ug programa nga gilunsad, apan ang kakulangan sa pondo ug ang kakulang sa implementasyon sa mga balaod ug regulasyon nagpakita sa kakulang sa suporta alang sa hugot nga pagpanalipod sa mga lumot."(**From my perspective, I see that the support from government agencies and other organizations for bryophyte conservation efforts in our area is not very strong. Although there are projects and programs being launched, the lack of funding and the insufficient implementation of laws and regulations indicate a lack of support for robust bryophyte conservation**). [Participant 1]

"Diri sa among lugar daghan nga mga proyekto ang gipatuman, maayu man sya alang sa paglambo sa among lugar pero wala sila kahibalo unsaon pag conserve sa mga tanom nga apekto ana nga proyekto." (**Here in our area, many projects are being implemented, and they are beneficial for the development of our place. However, they don't know how to conserve the plants affected by these projects**). [Participant 4]

Lack of support from government agencies and other organizations may affect the bryophytes conservation effort. Participant 1 and 4 feel concerned by the perceived neglect of important conservation efforts to raise awareness and advocate for protection. Additionally, they also feel disillusioned by the slow progress and insufficient resources allocated to address the threats facing bryophyte habitats.

The acknowledgment of insufficient financial resources allocated to bryophyte conservation initiatives reflects a systemic challenge in securing adequate funding for environmental protection programs. Limited funding can hinder the implementation of essential conservation activities, such as habitat restoration, research projects, and community outreach efforts, thereby impeding progress towards biodiversity conservation goals. Challenges include limited collaborative learning among forest and conservation planners, poor funding to conserve forest habitats with sufficient size, quality and connectivity, and national politics that ignores evidence-based knowledge (Angelstam et al. 2023).

Theme 5: Role of Collaborative Partnerships

Data analysis highlights the importance of collaborative partnerships in bryophyte conservation. Multi-stakeholder collaborations between government agencies, non-governmental organizations, academia, and local groups are identified as essential for mobilizing resources, enhancing capacity, and scaling up conservation efforts across the region. Collaboration lies at the core of much contemporary natural resource and conservation management. It is widely cited as a process suited to addressing and resolving conflict amongst stakeholders and coping with change and complexity (Wondolleck & Yaffee 2000; Daniels & Walker 2001; Sabatier et al. 2005; Armitage et al. 2009). It is argued that inclusive collaboration provides opportunities for learning, building trust and adaptive capacity, and achieving more durable decisions (Dandy, 2013).

The collaborative efforts described in the local response highlight the importance of partnerships between various stakeholders in bryophyte conservation. Such collaborations play a crucial role in leveraging diverse expertise, resources, and community engagement to address conservation challenges effectively. Adaptive leadership principles guided stakeholder engagement approaches that promoted collaborative governance, with stakeholders and staff working together to develop regulations for imperiled species management (Haubold, 2012)

Local Question:

Makahatag ka ba og mga eksperyensya o mga halimbawa sa mga successful nga mga kollaborasyon sa pagpanalipod sa mga lumot nga nahitabo sa inyong komunidad o rehiyon? (Could you share any experiences or examples of successful collaborations in bryophyte conservation that have occurred in your community or region?)

"Oo, may mga kasinatian ako sa akong komunidad diin ang mga lokal nga organisasyon, mga akademiko, ug ang mga miyembro sa komunidad nagtinabangay alang sa pagpanalipod sa mga lumot. Usa ka halimbawa mao ang pag-organisa og pamaagi sa pag-alam sa publiko mahitungod sa kahalangdon sa mga lumot ug ang ilang kalikupan. Kini nagresulta sa labing maayong pag-angkon sa suporta gikan sa lokal nga mga opisyal ug ang implementasyon sa mga lokal nga mga proyekto alang sa pagpanalipod sa mga lumot." (**Yes, I have experiences in my community where local organizations, academics, and community members collaborated for bryophyte conservation. One example is organizing public awareness campaigns about the importance of bryophytes and their environment. This resulted in better support from local officials and the implementation of local projects for bryophyte conservation.**) [Participant 2]

"Nakapamatikod ko nga daghan diri sa among lugar ang ga conduct ug mga research nga kalabutan sa mga conservation dili lang ang lumot kundi apil na lain tanom. Tungod kai naa pwedi e discover dri sa among lugar." (**I have noticed that many here in our place are conducting research related to conservation, not just about seaweed but also other plants. Because there might be discoveries that can be made here in our area**). [Participant 6]

Additionally, participant 2 and 6 share their experiences of successful collaborative partnership in bryophyte conservation, he also feels a sense of pride and accomplishment in highlighting the positive outcomes of collective action within their community. They may also feel encouraged by the recognition and support received from local officials and stakeholders, validating the importance of their conservation efforts.

The community's emphasis on securing the benefits and services provided by bryophytes reflects a commitment to sustainable resource management. By utilizing bryophytes' ecological services responsibly, such as for soil conservation, water filtration, and habitat provision, the community seeks to meet present needs

without compromising the ability of future generations to meet their own needs. Bryophytes provided important ecosystem services by colonizing rapidly, then stabilizing the soil, protecting it from wind and water erosion (Glime, 2024).

Community perspectives serve as valuable guiding principles for designing inclusive and effective bryophyte conservation strategies. By incorporating local knowledge, values, and priorities into conservation planning, stakeholders can enhance community engagement, build trust, and foster collaborative partnerships for achieving shared conservation goals.

Theme 6: Participatory Governance and Environmental Stewardship

The study of the relationship between humans and plants through ethnobotany has allowed recording this knowledge worldwide, producing extensive literature about their role in social belief systems, natural resources management, and human culture (Young 2007, Casas et al. 2014).The poor conservation outcomes that followed decades of intrusive resource management strategies and planned development have forced policy makers and scholars to reconsider the role of community in resource use and conservation Agrawal et al. (2000).

Discussions with community leaders and policymakers underscore the significance of participatory governance models and environmental stewardship in bryophyte conservation. Empowering local communities through inclusive decision-making processes and environmental education initiatives is seen as key to fostering long-term sustainability and resilience. The role of participatory approaches in natural resource management and highlight their potential for promoting community ownership and accountability in conservation initiatives.

Synthesizing these thematic insights, the qualitative analysis provides a comprehensive understanding of the complex socio-cultural, economic, and ecological dynamics shaping bryophyte conservation in Mindanao. This nuanced perspective informs recommendations for policy, practice, and future research aimed at safeguarding Mindanao's bryophyte diversity and its associated ecosystems.

Local Questions:

Unsa imong huna-huna nga ang mga lokal nga komunidad makatambong pa sa mga proseso sa paghimo og desisyon nga may kalabotan sa pagpanalipod sa mga lumot? (How do you think local communities can be more involved in decision-making processes related to bryophyte conservation?)

"Tungod sa akong pagtuo, ang mga lokal nga komunidad makatambong pa sa mga proseso sa paghimo og desisyon nga may kalabotan sa pagpanalipod sa mga lumot pinaagi sa paghatag sa ilang mga opinyon ug pag-ambit sa ilang mga kahibalo ug kahilom sa maong butang. Dili lamang kini magdala og labing maayong mga desisyon, apan mahatagan usab nila og kasiguruhan nga ang ilang mga tinubdan ug kinaiya pagrespetohan ug labing importante, matuman." (**In my opinion, local communities can further participate in decision-making processes related to bryophyte conservation by providing their opinions and sharing their knowledge and insights on the matter. This not only leads to better decisions but also ensures that their sources and nature are respected and prioritized.**) [Participant 5]

"Importanti nga ang mga lokal nga komunidad mag apil sa pagproseso sa pagtugot sa mga decision kung unsa ang mga maayu. Tungod kai wala man pud sila galantaw lang sa ilang kaugalingon kundi galantaw pud sila sa kaugmaon sa katawhan. Maong ang mga tanom di lang ang lumot maapil sa pag conserve aron naa pud makat-unan ug ma apply kini sa katawhan". (**It's important for local communities to be involved in the decision-making process regarding what's best. Because they don't just consider their own interests but also look at the future of the people. That's why plants, not just moss, should be included in conservation efforts so that people can learn and apply it)**. [Participant 6]

Openness in sharing their decision-making processes related to bryophyte conservation, he also feels a sense of empowerment and agency in shaping the future of their environment. They may feel encouraged by the idea that their voices and perspective are valued in decision making processes, reinforcing their sense of ownership and responsibility for bryophyte conservation.

The study underscores the urgent need for holistic, community-driven approaches to bryophyte conservation in Mindanao. By integrating traditional ecological knowledge with scientific expertise, conservation practitioners can develop context-specific strategies that resonate with local communities and promote sustainable resource management. Traditional ecological knowledge has the potential to guide both daily and ceremonial practices, whether conducted publicly or in more intimate settings. Certain ritualized practices strive to amalgamate the wisdom and experiential insights of multiple individuals to achieve heightened efficacy (Bruchac, 2014).

Furthermore, fostering partnerships between government agencies, non-

governmental organizations, academia, and local groups is essential for mobilizing resources, enhancing capacity, and scaling up conservation efforts across the region. Embracing participatory governance models and fostering environmental stewardship among future generations are crucial steps toward safeguarding Mindanao's bryophyte diversity and preserving its invaluable ecological heritage.

Local Ecological Knowledge (IEK) plays a vital role in bryophyte conservation, as it encompasses generations of traditional wisdom and practices passed down within communities. The insights gained from local knowledge systems offer valuable insights into the ecological significance of bryophytes and their interactions within ecosystems. In summary traditional ecological knowledge encompasses intricate, site-specific, and culturally-rooted guidelines ingrained within the landscape and manifested through distinct skill sets, practices, and localized insights. When adhered to diligently, these guidelines aim to guarantee not only immediate survival but also long-term human well-being, community resilience, and the safeguarding of distinctive ecosystems (Apffel-Marglin 2011; Berkes 2012).

Holistic Understanding of Bryophytes. Local communities have developed a holistic understanding of bryophytes, recognizing their multifaceted roles in maintaining ecological balance and providing ecosystem services. This knowledge encompasses not only the identification of bryophyte species but also their uses, ecological functions, and spiritual significance. Understanding diversity patterns and community structure of bryophytes will help integrate nature conservation at multiple biotic-group levels. Until now, little has been known about the diversity patterns of bryophytes, their spatial heterogeneity, their role in forest community assembly, and their biotic and abiotic interactions to maintain the ecosystem function as a whole (Jiang et al., 2018).

Sustainable Use Practices: Traditional practices related to bryophytes often emphasize sustainable harvesting techniques and resource management strategies that have been refined over generations. These practices reflect a deep-seated respect for nature and a recognition of the interconnectedness between humans and the environment. For instance, research on bryophyte assemblages in traditionally managed grasslands emphasizes the significance of environmental drivers and traditional management practices in shaping bryophyte communities (Janišová et al., 2022). Additionally, studies on the uses and traditional knowledge of bryophytes in local communities underscore the importance of recording and preserving this knowledge to prevent its loss (Hernández-Rodríguez & López-Santiago, 2021).

Cultural Significance: Bryophytes hold cultural significance within local communities, often featuring prominently in rituals, ceremonies, and folklore. The cultural value attributed to bryophytes underscores the intimate relationship between people and nature, shaping conservation attitudes and behaviors.

The cultural significance of bryophytes within local communities, as highlighted in the research, underscores the deep-rooted relationship between people and nature, influencing conservation attitudes and behaviors. Moreover, investigations into the representation of cultural values in rituals and folklore among various indigenous tribes highlight the importance of preserving and understanding traditional practices (Putri et al., 2019; Sutrisno et al., 2020). Studies on the implications of ritual practices on nature conservation underscore the need for further research to explore the role of traditional beliefs in biodiversity conservation (Geng et al., 2017).

Incorporating Local Ecological Knowledge into bryophyte conservation initiatives is essential for promoting culturally sensitive and community-driven approaches. By recognizing the invaluable contributions of Local communities and integrating their knowledge systems with scientific expertise, we can develop more effective and sustainable conservation strategies that honor the intricate relationship between people and nature in Mindanao.

Promoting participatory governance requires creating enabling environments that facilitate meaningful engagement, dialogue, and collaboration among stakeholders. By integrating diverse perspectives, knowledge systems, and values into decision-making processes, local communities can become empowered agents of change, driving more inclusive, equitable, and sustainable bryophyte conservation initiatives.

CONCLUSION

Bryophytes play a pivotal role in shaping the ecological fabric of Mindanao, yet their conservation remains a marginalized endeavor amidst competing development priorities. This qualitative research underscores the importance of recognizing bryophytes as integral components of biodiversity conservation and sustainable development agendas in Mindanao. By amplifying local voices, fostering collaboration, and nurturing a culture of environmental stewardship, we can forge a more resilient and inclusive approach to bryophyte conservation that honors the intricate interplay between humans and nature in the diverse landscapes of Mindanao, Philippines. Despite a growing awareness

of the importance of bryophyte conservation among local stakeholders, there are considerable obstacles, including limited institutional support, funding constraints, and insufficient scientific research. Integrating traditional ecological knowledge with scientific expertise and fostering multi-stakeholder collaborations are essential for effective bryophyte conservation.

RECOMMENDATIONS

Recommendations for Bryophyte Conservation: Collaborative Strategies to Safeguard Mindanao's Green Heritage:

1. To Local Government. Provide support and funding for community-led conservation initiatives by collaborating with local communities, elders, and traditional practitioners. Facilitate multi-stakeholder collaborations by establishing platforms for dialogue and resource-sharing among government agencies, NGOs, academia, and local groups. Advocate for increased institutional support and funding allocation for bryophyte conservation projects within government budgets and development plans;

2. To Non-Governmental Organizations (NGOs). Support community-led conservation initiatives by providing technical assistance, capacity-building workshops, and funding opportunities. Actively participate in multi-stakeholder collaborations to leverage resources and expertise for effective conservation action. Engage local communities through participatory approaches and educational campaigns to promote environmental stewardship and community involvement in conservation efforts;

3. To Stakeholders. Participate in community-led conservation initiatives, contribute traditional knowledge, and engage in decision-making processes related to bryophyte conservation. Conduct further research on bryophyte diversity, distribution, and conservation needs, collaborating with local communities and other stakeholders. Consider the environmental impact of business activities on bryophyte habitats and explore opportunities for sustainable practices and corporate social responsibility initiatives;

4. To Researchers. Conduct comprehensive research on bryophyte ecology, threats, and conservation strategies, using study findings as a foundation for

further investigation. Foster partnerships with local stakeholders, including communities, NGOs, and government agencies, to co-design research projects and facilitate knowledge exchange; and

5. Educational Institutions. Universities, colleges, and schools can integrate the study findings into their curricula to educate students about bryophyte ecology, conservation issues, and the importance of biodiversity conservation.

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