

Short Research Article

Rapid Assessment of Riparian Vegetation at Calyawan River, Barangay Andap, Municipality of New Bataan, Davao de Oro Province, Philippines

Abstract

Aims: The **objective aim** of this study was to examine the vegetation found along the riverbanks of the Calyawan River in Barangay Andap, Municipality of New Bataan, Province of Davao de Oro, Philippines using the transect walk method. The goals were to determine the variety and abundance of the flora along the riverbank, evaluate the conservation status of the discovered plant species, and suggest measures for safeguarding and preserving the riparian environment.

Study Design: The study employed a transect walk method to carry out an initial survey of the riparian vegetation. A 1-kilometer transect was conducted along the riverbanks of the Calyawan River to gather qualitative and quantitative measurements of plant diversity. The evaluation took place on December 20, 2022. This approach facilitated a quick and systematic examination of the vegetation along the riverbanks.

Place and Duration: The study was carried out on the riverbanks of the Calyawan River in Barangay Andap, Municipality of New Bataan, Province of Davao de Oro. The fieldwork was conducted on December 20, 2022. The region can be reached by using the Compostela-Montevista-Mati Boundary Road.

Methodology: The transect walk approach was employed to record the riparian flora during the survey. Plant species were identified and photographed, but no tangible plant specimens were collected. The obtained data encompassed the identification of fern and angiosperm taxa and families encountered along the transect. The conservation status assessments were conducted using the pre-existing classifications of the species.

Results: A rapid assessment revealed the presence of 49 distinct genera of ferns and angiosperm plants belonging to 30 different families along the transect. Out of these, 74% of the riparian plant genera that were identified **were and** found to be endemic to the region. The assessment of the riparian plants' conservation status indicated that 37% were classed as vulnerable, 30% as least concern, 22% as other threatened species, 10% as endangered, and 1% were not categorized. Although the sample time was short, these findings emphasize the abundance and importance of the riparian flora in terms of conservation.

Conclusion: The initial study conducted along the riverbanks of Calyawan River indicated a notable variety of plants that grow along the river, with a large number of species that are unique to that area. Many identified plants have a conservation status that emphasizes the necessity for heightened sampling efforts and monitoring in order to gain a more comprehensive understanding **of** and safeguard this rich ecosystem. Considering the clear human-induced stresses on the forest fragments in the region, it is advisable to enhance and broaden conservation efforts in order to protect the riparian vegetation and guarantee its ongoing existence.

Keywords: angiosperm, riparian, calyawan river, rapid assessment, vegetation

1. INTRODUCTION

Riparian zones are the areas next to streams and shorelines that link waterways with runoff from higher ground through both surface and underground channels. The biodiversity of these habitats is among the highest of any terrestrial ecosystems found on any of the planet's continents. The geologic and ecoregional setting, the form and distribution of water and sediment supply, connectivity, and the regional species pool are the factors that regulate the physical form, the seasonal and interannual flow and sediment regime, and collectively they define the possibilities and restrictions that are associated with riparian biota [1].

Riparian vegetation, often known as plants growing along the banks, primarily consists of hydrophilic species. Hydrophilic plants have a crucial role in mitigating nonpoint source pollution in rivers and rehabilitating the water quality of degraded streams or rivers [2]. In addition, riparian vegetation has a significant impact on the chemistry of stream water through several means. This includes the direct absorption of chemicals, as well as indirect impacts such as the introduction of organic matter into the soil and channels, changes in water flow, and the stabilization of soil [3]. In general, riparian vegetation serves directly in stabilizing ecological system [4], maintaining water quality [5], and flood mitigation and management [6]. Because riparian habitats are highly diverse, dynamic, and complex settings, there has been global focus on their protection and conservation [7;8].

The Calyawan River, originating in Barangay Andap, Municipality of New Bataan, Province of Davao de Oro, has not been well explored in terms of its riparian vegetation. The Province of Davao de Oro is now providing financial support for preliminary biodiversity studies, despite the existence of incomplete data in the province. It is worth noting that this province and its towns have been attracting visitors because of the presence of stunning landscapes, a generally cold climate, and captivating freshwater bodies such as rivers and streams.

Riparian vegetation plays a crucial role in maintaining ecological balance, yet it faces numerous threats from anthropogenic activities. Understanding these dynamics is essential for conservation efforts [4]. Conducting biodiversity surveys is crucial at this time due to the urgent tourist activities at the site. This will enable the development of effective management strategies to preserve the area's scenic views, which are a result of the abundant presence occurrence of animals and plants. Additionally, it will help promote ecotourism in the region. Thus, this rapid evaluation of riparian species was conducted primarily in response to the lack of published research on biodiversity, specifically riparian vegetation, in Barangay Andap, Municipality of New Bataan, Province of Davao de Oro.

2. MATERIAL AND METHODS

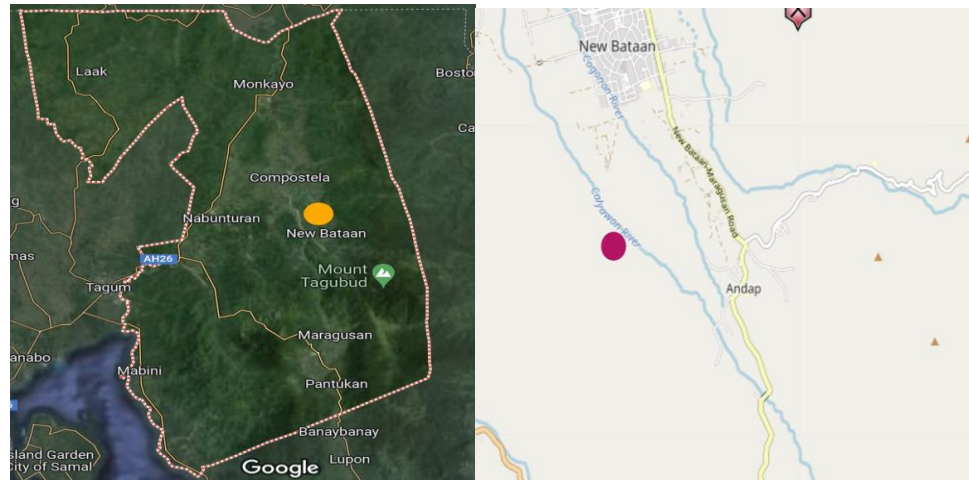
Research Site:

A preliminary study of the vegetation along the riverbanks of Calyawan River was conducted at Barangay Andap, Municipality of New Bataan, Province of Davao de Oro (Fig. 1). The sampling area can be reached by using the Compostela-Montevista-Mati Boundary Road. The assessment was conducted on December 20, 2022.

The sampling location is situated in the municipality of New Bataan, which is geographically surrounded by mountain ranges. Additionally, over half of its land area is occupied by forests, which have served as a source of livelihood for certain individuals. The

barangays in New Bataan with the highest forest cover are Andap, Tandawan, Camanlangan, and Manurigao. Several rivers also supply water to the area. One such example is the Calyawan River, which originates from the mountain in Barangay Andap.

Figure 1. Map Barangay Andap, Municipality of New Bataan, Province of Davao de Oro.



Sampling Method:

A transect measuring one kilometer in length was traversed along the riverbanks of the Calyawan River in Barangay Andap, located in the Municipality of New Bataan, inside the Province of Davao de Oro. The transect walk method offers rapid and quantitative assessments of richness and diversity for comparative surveys. This approach has been documented in studies by Spitzer et al. (1997), as well as in unpublished trips to Panama conducted by Thomas and Cheverton in 1978, and to Ghana by Spalding and others in 1989. Photographs were taken of riparian plants whenever they were encountered during the tour. The plant samples were not collected.

Species Classification:

The process of identifying and categorizing the species was incorporated into the species composition. Genus-level taxonomic identification was conducted based on the existing published literature, which includes species accounts. The following sources were consulted: Madulid (1995), Fernando et al. (2004), Co et al. (2006), Pancho and Gruezo (2008), Flora Malesiana Series (1995-2007), and Co's Digital Flora of the Philippines [11]. Online platforms such as iNaturalist and Google Lens were also utilized for taxonomic identification. All plants were recognized and categorized ecologically as either endemic, native/indigenous, or introduced/exotic.

The present conservation status and population information for each species were derived from the online reference of the International Union for Conservation of Nature (redlist.org) and the DENR Administrative Order of 2017, which provides an updated national list of threatened Philippine plants and their respective categories (DAO 2017-1).

Limitation of the Study:

This study specifically examined two categories of plants: ferns and angiosperms. The identification of riparian plants is limited to the genus level.

3. RESULTS AND DISCUSSION

Number of Families and Genera of Ferns and Angiosperm in the Area

A rapid survey was conducted to determine the classification of riparian plants at the sampling location. The Angiosperm and Fern groups of plants are members of the plant family recorded. A total of 30 families and 49 genera were identified and recorded [Table 1].

The data is supported by many literatures stating that the angiosperms are the most varied group of terrestrial plants. With an estimated 225, 000 to 425, 000 species that are divided into over 400 families, these families are distinguished by a set of new characteristics that include the flower, fruits, and seed endosperm [11]. On the other hand, ferns are particularly prevalent in tropical regions and share a strong relationship with angiosperms due to the fact that both types of plants are vascular. The remarkable endurance of ferns to a wide variety of environmental conditions is likely responsible for the profusion of ferns that can be found in riparian zones [12].

Table 1. Total Number of Families and Genera of Ferns and Angiosperm at Calyawan River, Barangay Andap, Municipality of New Bataan, Davao de Oro Province, Philippines

Plant Groups	Family	Genera
Angiosperm	21	36
Ferns	9	13

Classification of Plant Species in Riparian Vegetation.

As shown in Table 2, Angiosperm groupings are best represented by the Fabaceae family, which has five genera, while fern families are best represented by Polypodiaceae, which has three genera. The dominant family in the current dataset with three genera, Family Polypodiaceae, is consistent with previous studies on fern flora in different mountain ranges in Mindanao [13, 14]. The Polypodiaceae family is commonly encountered in surveys because its members possess the ability to thrive in both temperate and wet tropical regions, including the northern hemisphere [15]. The presence of this family is directly related to its function as the essential component in the process of lowering the number of materials transmitted from the terrestrial environment to the aquatic environment [16].

Within the Angiosperm category of plants, the Family Fabaceae had the maximum number of genus representatives in the area. This family is ranked third in terms of the number of species among Angiosperms worldwide [17]. The prevalence of the Family Fabaceae is directly correlated with its ecological and economic significance. They contribute to the enhancement of soil nitrogen levels and serve as a substantial protein source for both people and livestock. Some species are utilized as a source of food or medicine [18].

Table 2. Biological Classification of riparian flora accounted at Calyawan River, Barangay Andap, Municipality of New Bataan, Province of Davao de Oro, Philippines

Plant Category	Family	Genus
Angiosperm	<i>Amaranthaceae</i>	- <i>Amaranthus</i> - <i>Celosia</i>
Angiosperm	<i>Araceae</i>	- <i>Alocasia</i> - <i>Epipremnum</i> - <i>Syngonium</i> - <i>Xanthosoma</i>
Angiosperm	<i>Asteraceae</i>	- <i>Acmella</i> - <i>Chromolaena</i> - <i>Mikania</i>
Angiosperm	<i>Costaceae</i>	- <i>Hellenia</i>
Angiosperm	<i>Euphorbiaceae</i>	- <i>Euphorbia</i> - <i>Macaranga</i>
Angiosperm	<i>Fabaceae</i>	- <i>Desmodium</i> - <i>Gliricidia</i> - <i>Mimosa</i> - <i>Neusthantus</i> - <i>Senna</i>
Angiosperm	<i>Lamiaceae</i>	- <i>Hyptis</i>
Angiosperm	<i>Lindsaeaceae</i>	- <i>Odontosoria</i>
Angiosperm	<i>Lygodiaceae</i>	- <i>Lygodium</i>
Angiosperm	<i>Malvaceae</i>	- <i>Pachira</i> - <i>Theobroma</i>
Angiosperm	<i>Meliaceae</i>	- <i>Swietenia</i>
Angiosperm	<i>Menispermaceae</i>	- <i>Pericampylus</i>
Angiosperm	<i>Moraceae</i>	- <i>Artocarpus</i>
Angiosperm	<i>Oxalidaceae</i>	- <i>Oxalis</i>
Angiosperm	<i>Piperaceae</i>	- <i>Piper</i>
Angiosperm	<i>Poaceae</i>	- <i>Bambusa</i> - <i>Cymbopogon</i> - <i>Melinis</i> - <i>Imperata</i>
Angiosperm	<i>Portulacaceae</i>	- <i>Portulaca</i>
Angiosperm	<i>Rutaceae</i>	- <i>Citrus</i>
Angiosperm	<i>Sapotaceae</i>	- <i>Synsepalum</i>
Angiosperm	<i>Solanaceae</i>	- <i>Solanum</i>
Angiosperm	<i>Verbenaceae</i>	- <i>Lantana</i>
Fern	<i>Aspleniaceae</i>	- <i>Asplenium</i>
Fern	<i>Athyriaceae</i>	- <i>Diplazium</i>
Fern	<i>Blechnaceae</i>	- <i>Blechnum</i> - <i>Stenochalena</i>
Fern	<i>Cyatheaceae</i>	- <i>Sphaeropterisglauca</i>
Fern	<i>Marratiaceae</i>	- <i>Angiopteris</i>
Fern	<i>Osmundaceae</i>	- <i>Osmunda</i>
Fern	<i>Polypodiaceae</i>	- <i>Aglaomorpha</i> - <i>Lepisorus</i> - <i>Microsorium</i>
Fern	<i>Pteridiceae</i>	- <i>Adiantum</i> - <i>Pteris</i>

Fern	Thelypteridaceae	- <i>Chingia</i>
------	------------------	------------------

Conservation and Ecological status of Riparian vegetation

The assessment of plant diversity in riparian regions indicates a worrisome condition across different genera, underscoring the necessity for conservation endeavors as depicted in Table 3. In terms of the biological condition of riparian plants, 74% of the plants found in the region are native to that specific area, while the remaining 26% are not native. Moreover, the study showed the effective conservation of riparian plants in the studied area.

Moreover Moreover, the data reveals a substantial quantity of endangered and fragile plant taxa belonging to ferns and Angiosperms, highlighting the ecological significance of these ecosystems. Two genera from the Angiosperms and three genera from the Ferns are categorized as endangered, indicating the precarious condition of certain species that are at risk of becoming extinct unless action is taken [19]. Out of the total of eighteen genera classified as vulnerable, twelve belong to angiosperms and the remaining seven belong to fern plants. The vulnerable category signifies that they are in a precarious position and are susceptible to becoming threatened [20]. All sixteen genera classified as least concern belong to the category of Angiosperm plants, indicating a largely steady population status [19]. There are a total of eleven genera that are classified under other threatened categories, with nine of them belonging to angiosperms and the remaining two belonging to fern plants.

Although the data reveals a negative representation of plant diversity in riparian areas, it also underscores the capacity of conservation methods to alleviate these risks and reinstate ecological equilibrium. Humans do significant damage to riparian plant communities, which are highly dynamic and complex systems that support a wide range of species. Furthermore, alterations in land use have had an impact on the diversity of species in riparian vegetation [21]. This highlights the wide range of dangers that riparian vegetation encounters.

Table 3. Endemism, ecological and conservation status of riparian flora accounted in Calyawan River, Barangay Andap, Municipality of New Bataan, Province of Davao de Oro.

Family/Genus	Plant Group	Ecological Status	Conservation Status
Amarantheceae - <i>Amaranthus</i> - <i>Celosia</i>	Angiosperm Angiosperm	Non-Endemic Non-Endemic	LC LC
Araceae - <i>Alocasia</i> - <i>Epipremnum</i> - <i>Syngonium</i> - <i>Xanthosoma</i>	Angiosperm Angiosperm Angiosperm Angiosperm	Endemic Endemic Endemic Endemic	Vu Vu Vu Vu
Aspleniaceae - <i>Asplenium</i>	Fern	Non-Endemic	Vu
Asteraceae - <i>Acmella</i> - <i>Chromolaena</i> - <i>Mikania</i>	Angiosperm Angiosperm Angiosperm	Endemic Non-Endemic Non-Endemic	LC LC LC NT
Athyriaceae - <i>Diplazium</i>	Fern	Non-Endemic	NA

Blechnaceae - <i>Blechnum</i> - <i>Stenochalena</i>	Fern Fern	Endemic Non-Endemic	Vu NA
Costaceae - <i>Hellenia</i>	Angiosperm	Endemic	Vu
Cyatheaceae - <i>Sphaeropterisglauca</i>	Fern	Non-Endemic	EN
Euphorbiaceae - <i>Euphorbia</i> - <i>Macaranga</i>	Angiosperm Angiosperm	Endemic Endemic	Vu OTS
Fabaceae - <i>Desmodium</i> - <i>Gliricidia</i> - <i>Mimosa</i> - <i>Neusthantus</i> - <i>Senna</i>	Angiosperm Angiosperm Angiosperm Angiosperm Angiosperm	Endemic Endemic Endemic Endemic Endemic	OTS OTS OTS OTS OTS
Lamiaceae - <i>Hyptis</i>	Angiosperm	Endemic	Vu
Lindsaeaceae - <i>Odontosoria</i>	Angiosperm	Endemic	Vu
Lygodiaceae - <i>Lygodium</i>	Angiosperm	Non-Endemic	LC
Malvaceae - <i>Pachira</i> - <i>Theobroma</i>	Angiosperm Angiosperm	Endemic Endemic	EN LC
Marratiaceae - <i>Angiopteris</i>	Fern	Non-Endemic	OTS
Meliaceae - <i>Swietenia</i>	Angiosperm	Endemic	Vu
Menispermaceae - <i>Pericampylus</i>	Angiosperm	Endemic	Vu
Moraceae - <i>Artocarpus</i>	Angiosperm	Endemic	OTS
Osmundaceae - <i>Osmunda</i>	Fern	Endemic	OTS
Oxalidaceae - <i>Oxalis</i>	Angiosperm	Endemic	OTS
Piperaceae - <i>Piper</i>	Angiosperm	Endemic	OTS
Poaceae - <i>Bambusa</i> - <i>Cymbopogon</i> - <i>Melinis</i> - <i>Imperata</i>	Angiosperm Angiosperm Angiosperm Angiosperm	Endemic Endemic Endemic Endemic	LC LC LC LC
Polypodiaceae - <i>Aglaomorpha</i> - <i>Lepisorus</i> - <i>Microsorium</i>	Fern Fern Fern	Non-Endemic Endemic Endemic	Vu EN Vu
Portulacaceae - <i>Portulaca</i>	Angiosperm	Endemic	LC
Pteridiceae - <i>Adiantum</i>	Fern	Endemic	Vu

- <i>Pteris</i>	Fern	Endemic	Vu
Rutaceae			
- <i>Citrus</i>	Angiosperm	Non-Endemic	LC
Sapotaceae			
- <i>Synsepalum</i>	Angiosperm	Endemic	EN
Selaginellaceae			
- <i>Selaginella</i>	Lycophytes	Endemic	EN
Solanaceae			
- <i>Solanum</i>	Angiosperm	Endemic	LC
Thelypteridaceae			
- <i>Chingia</i>	Fern	Endemic	Vu
Verbenaceae			
- <i>Lantana</i>	Angiosperm	Non-Endemic	LC

***Status:EN**= Endangered; **OTS**= Other Threatened Species; **VU**= Vulnerable; **LC**- Least Concern; **NA**-No assessment; Conservation status follows that of International Union for the Conservation of Nature(redlist.org, 2017) and DENR Administrative Order. 2017. Updated national list of threatened Philippine plants and their categories. DAO 2017-11.

4. CONCLUSION

A total of 49 genera of ferns and angiosperm plants belonging to 30 families were identified in the sampling site along the riverbanks of the Calyawan River in Barangay Andap, Municipality of New Bataan, Province of Davao de Oro, despite the little time available for sampling. The 74% of the riparian plant genera are endemic, making up the majority of the reported plants. Evaluation of the status was required as the foundation for the protection, conservation, and monitoring of the species. 37 percent of the riparian plants that have been identified in the area are vulnerable, 30 percent are of least concern, 22 percent are other threatened species, 10 percent are endangered, and 1 percent have not been classified.

Therefore, it is advised that sampling efforts at the site be increased to expand the limited area covered, especially given that the region has evident anthropogenic activities, which have put a lot of strain on the fragments of forest and its flora.

REFERENCES

- [1] Özgenç, E. K. Exploring the wide-ranging ecosystem services of riparian vegetation on a global scale. *Turkish Journal of Forestry*, 25(2), 233-243.
- [2] Dosskey, M. G., Vidon, P., Gurwick, N. P., Allan, C. J., Duval, T. P., & Lowrance, R. (2010). The role of riparian vegetation in protecting and improving chemical water quality in streams 1. *JAWRA Journal of the American Water Resources Association*, 46(2), 261-277.
- [3] Kellogg, D.Q., A.J. Gold, P.M. Groffman, M.H. Stolt, and K. Addy, 2008. Riparian Ground-Water Flow Patterns Using Flownet Analysis: Evapotranspiration-Induced Upwelling and Implications for N Removal. *Journal of the American Water Resources Association* 44(4):1024-1034.

- [4] Hoppenreijns, J. H., Eckstein, R. L., & Lind, L. (2022). Pressures on boreal riparian vegetation: A literature review. *Frontiers in Ecology and Evolution*, 9, 806130.
- [5] Poff, B., Koestner, K. A., Neary, D. G., & Merritt, D. (2012). Threats to western United States riparian ecosystems: A bibliography. *Gen. Tech. Rep. RMRS-GTR-269*. Fort Collins, CO: US Department of Agriculture, Forest Service, Rocky Mountain Research Station. 78 p., 269.
- [6] Jumain, M., Ibrahim, Z., Ismail, Z., Entalai, K., Makhtar, M. R., Rahman, M. S. A., & Alias, N. (2018, July). Influence of riparian vegetation on flow resistance in mobile bed straight compound channels. In *Journal of Physics: Conference Series* (Vol. 1049, No. 1, p. 012027). IOP Publishing.
- [7] Naiman, R. J., & Decamps, H. (1997). The ecology of interfaces: riparian zones. *Annual review of Ecology and Systematics*, 621-658.
- [8] Zaines GN (2020) Mediterranean riparian areas-climate change implications and recommendations. *Journal of Environmental Biology* 41: 957-965
- [9] Spitzer, Karen, Josef Jaroš, Jan Havelka, Jan Lepš, 1997, Effect of small-scale disturbance on butterfly communities of an Indochinese montane rainforest, *Biological Conservation*, Volume 80, Issue 1, 1997, Pages 9-15, ISSN 0006-3207, [https://doi.org/10.1016/S0006-3207\(96\)00079-1](https://doi.org/10.1016/S0006-3207(96)00079-1).
- [10] Pelsner, P.B., J.F. Barcelona & Nickrent, D.L. (eds.), 2011 onwards. Co's Digital Flora of the Philippines. www.philippineplants.org Schneider, H., E. Schuettpelez, K. Pryer, R. Cranfill, S. Magallón and R. Lupia. 2004. Ferns diversified in the shadow of angiosperms. *Nature* 428: 553–557.
- [11] Paterson, A. (2013). *Genomes of herbaceous land plants*. Elsevier.
- [12] Hietz, P. (2010). Fern adaptations to xeric environments. *Fern ecology*, 140-176.
- [13] Amoroso, V. B., Coritico, F. P., & Fritsch, P. W. (2016). Species richness and conservation status of ferns and lycophytes in Mt. Hamiguitan Range Wildlife Sanctuary, Davao Oriental, Philippines. *Philippine Journal of Science*, 145(2), 127-137.
- [14] Coritico, F. P., Amoroso, V. B., Acma, F. M., Cariño, Y. L. L., & Fritsch, P. W. (2020). Ferns and lycophytes of Mt. Tago Range, Bukidnon, Southern Philippines: species richness, distribution, and conservation status. *Philippine Journal of Science*, 149, 773-790.
- [15] Sundue, M. A., Parris, B. S., Ranker, T. A., Smith, A. R., Fujimoto, E. L., Zamora-Crosby, D., ... & Prado, J. (2014). Global phylogeny and biogeography of grammitid ferns (Polypodiaceae). *Molecular Phylogenetics and Evolution*, 81, 195-206.
- [16] Anbumozhi, V., Radhakrishnan, J., & Yamaji, E. (2005). Impact of riparian buffer zones on water quality and associated management considerations. *Ecological Engineering*, 24(5), 517-523.
- [17] Koenen, E. J., Ojeda, D. I., Steeves, R., Migliore, J., Bakker, F. T., Wieringa, J. J., ... & Hughes, C. E. (2020). Large-scale genomic sequence data resolve the deepest divergences in the legume phylogeny and support a near-simultaneous evolutionary origin of all six subfamilies. *New Phytologist*, 225(3), 1355-1369.

[18] Molares, S., & Ladio, A. (2012). The usefulness of edible and medicinal Fabaceae in Argentine and Chilean Patagonia: environmental availability and other sources of supply. *Evidence-Based Complementary and Alternative Medicine*, 2012. Naiman RJ, De´ Camps H (1997) The ecology of in-terfaces: Riparian zones. *Annual Review of Ecology and Systematics* 28: 621-658.

[19] Gautam, M., & Gupta, S. (2015). Population status and conservation requirement of some endangered plants growing in Dayalbagh Educational Institute, Agra. *International Journal of Conservation Science*, 6(4).

[20] Amaludin, N. A., Zulkafli, N. M., Zu, S. A., Zamri, N. A. Z., Ab Majid, N. A., Daliman, S., ... & Zakaria, R. (2022, June). Analysis of riparian vegetation of a recreation site in Jeli, Kelantan. In *IOP Conference Series: Earth and Environmental Science* (Vol. 1053, No. 1, p. 012007). IOP Publishing.

[21] Lubos, L. C., Amoroso, V. B., Coritico, F., & Demetillo, M. (2015). Species richness and riparian vegetation of plants in Cagayan de Oro River, Mindanao, Philippines. *Asian Journal of Biodiversity*, 6(2).

UNDER PEER REVIEW