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Diversity and composition of riparian vegetation across forest and agro-ecosystem landscapes of Cabadbaran River, Agusan del Norte, Philippines

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Abstract

The Cabadbaran River Irrigation System (CabRIS) supports about 3,212 hectares of farmland for irrigation. Unfortunately, the local irrigation office reported that only a small percentage of its entire service area was irrigated during the past cropping seasons. The water yield has been dwindling; hence an irrigation system management plan will address the water resource crisis. As a project component, the team carried out a floristic assessment for the entire watershed. The study used the quadrat-transect sampling method to assess and characterize the structure and species composition of the riparian areas of the main Cabadbaran River, Cabadbaran City, Agusan del Norte, Philippines. Results recorded about 109 morpho-species belonging to 46 families and 88 genera from the sampling sites. Nineteen species were listed either on the Philippine Red List and or on the IUCN Red List of Threatened Species. The result of the plant diversity assessment revealed that biodiversity in riparian forests in the watershed was low to very low due to the massive rampant disturbance in the area. The riparian ecosystem of the Cabadbaran River represents a fragile ecosystem that is threatened by increasing demands on the regional water supply and the conversion of lands into tree plantations and agriculture. Addressing these driving forces causing biodiversity loss will impart a significant challenge for irrigation and land managers in the region.

Keywords

CabRIS, Plant diversity, Riparian flora, Threatened species, irrigation system

Introduction

From the beginning of human history, the importance of rivers for human survival cannot be overstated and its significant role in the life of people, channels of materials and energy,

and in the development of the settlements (Tochner and Ward 1999; Maciukenaite and Povilaitienė 2013; Sankhwal et al. 2015). Even in modern life, it is surprising just how much people rely on rivers for livelihood and economies (Buzarboruah 2014). The value of rivers shows no signs of slowing down, but in fact, has been progressively expanding from merely being used as a source of potable water to drink, for irrigation, agricultural purposes and source of food, to the transport of goods and services, and recently in the development of hydroelectricity as a renewable source of energy (Ozigis et al. 2019).

The Cabadbaran River is the main channel of the 16,025 hectares protected area of the Cabadbaran River Watershed Forest Reserve (CRWFR) established by virtue of Proc. No. 834 by President Corazon C. Aquino in 1991. The aim is to provide protection, maintenance, and improvement of water yield and to provide a restraining mechanism for inappropriate forest exploitation and disruptive land uses in the watershed (Philippines 1991). Supporting about 3,212 hectares of farmlands and benefiting 2,205 farmer-beneficiaries in Agusan del Norte, the watershed was a top priority for development and considered a critical watershed as listed under the Department of Environment and Natural Resources (DENR-FMB 2013).

With more than a decade in service and operation, the local irrigation office reported a declining water yield in the watershed, especially during the dry seasons. Surface water was dwindling as a large fraction of rice fields under the irrigation system were not served. Similar with other watersheds, the riparian forests are increasingly threatened by urban expansion and land use change (Burton and Samuelson 2008). It is, therefore, necessary to revisit, formulate and update the irrigation management plan to address the water crisis.

As riparian areas are among the most diverse, dynamic and complex habitats, it has become a priority worldwide such that information herein is critical for the better protection and conservation of the watershed (Naiman and De ´Camps 1997; Zaimes 2020). This paper is a product of a comprehensive biological survey as part of an irrigation management plan formulation commissioned by the Philippine government. It provides an inventory as a baseline information of the riparian flora of the main Cabadbaran River including stand structure, plant diversity, endemism, and ecological status.

Material and methods

The floristic inventory was carried out on August 2021 along forest patches of the Cabadbaran River. Starting from the irrigation dam structure, the main river channel was divided into three sections namely downstream, midstream, and upstream. A line plot method was used to assess and characterize the structure and species composition of the different plant communities. A 20 m x 20 m sampling quadrat was used for the study. Five quadrats at an interval of 250 m were laid out on each side of the river or a total of 10 quadrats were established per section. All large woody plants with diameters ≥ 10 cm, measurements of diameter at breast height (DBH), and total height (TH) were taken. A total of thirty quadrats were established along the main Cabadbaran channel.

An additional five more quadrats were established on the headwater forests to assess other tree species found in the protected areas of the watershed. A digital camera was used to document all species including rattans, bole climbers, bamboos, lianas, and palms. Overall, a total of thirty-five quadrats were surveyed with elevations ranging from 50 m to 250 m above sea level (Fig. 1).

To account for other flora species occurring outside sampling quadrats, an additional survey was made using the transect method. For every section in the main river, the 1-km transect in-lined with the sampling quadrats was laid out along the riparian zone and its opposite bank. Additional transects were also laid-out on other remaining forest patches adjacent the main river channel. The survey involved only a listing of species encountered without any measurements.

The Paleontological Statistics Software (PAST 4.03) was used to generate the different diversity indices (i.e. Shannon (H'), Simpson's (D), and Evenness (J) for each quadrat. Shannon Index gives an estimate of species richness and distribution. Evenness Index indicates how evenly species and/or individuals are distributed inside a plot or quadrat. Simpson's Index gives the probability of getting different species when two individuals were drawn (without replacement) inside a plot (Malabrigo et al. 2014).

In addition, the ecological and conservation status of the different species was assessed using the IUCN (2021-2) and the Philippine Red List (Fernando et al. 2008) for threatened species. Species names were counter checked in WFO (2022) while the common names adapted that of Rojo (1999).

Results and Discussion

Tree Species diversity and assessment

For trees and other arborescent species inside sampling quadrats, a total of 465 individuals with 52 species were recorded to have a DBH of more than 10 cm. The majority of the quadrats surveyed have less than 20 individuals per quadrat (Fig. 2), and only 5 quadrats have recorded 20 individuals or more. The average number of trees per quadrat is only 13 individuals or an average density of 0.03 tree/m^2 (3 trees for every 100 m^2) only. Majority of the surveyed quadrats are classified to have "very low" diversity with index values less than 2.00 (Fig. 3). The low tree density of the quadrats can be attributed to the massive clearing of the riverbanks for plantation and agricultural purposes since most of the quadrats fall on areas planted with Falcata (*Falcataria moluccana* (Miq.) Barneby & J.W.Grimes.). In addition, most riparian tree species (*e.g. Ficus spp.*) are naturally small-diameter trees. The tree with the largest diameter was While Lauan (*Shorea contorta* S.Vidal) which recorded a DBH of 176.5 cm, followed by Bagtikan (*Parashorea malaanonan* Merr.), Tagkan (*Palaquium pinnatinervium* Elmer), Tanguile (*Shorea polysperma* (Blanco) Merr.), and Panau (*Dipterocarpus gracilis* Blume). All of which were recorded in the forested areas of the headwaters (protected area) of the watershed.

Importance Value

The data was tabulated on a spreadsheet to determine the relative density, relative dominance, and relative frequency values for each tree species; the requisite values needed to obtain the Species Importance Value (SIV). High Importance values of species indicate a composite score for high relative species dominance, density, and frequency. Based on the computed IV (Table 1), the five most important species (with the highest IV) for the whole watershed area are Falcata (*F. moluccana*) (82.95), White Lauan (*S. contorta*) (26.38), Coconut (*Cocos nucifera*) (24.59), Antipolo (*Artocarpus blancoi*) (15.70) and Lapnis (*Broussonetia papyrifera*) (11.63). Since most of the sampling quadrats fall on disturbed agricultural and plantation areas, it was expected that species composition will be those that can be traded commercially like Falcata and Coconut, and other miscellaneous species that occur after disturbance known to be water-loving species hence, commonly found in rivers and creeks.

Diversity Indices

The computed Shannon Index from the different sampling quadrats varies from a very low of 0.377 to a low of 2.243 (Table 2). Following the diversity classification scheme based on the suggested range of Shannon Index by Fernando et al. (1998), only two quadrats were considered to have low diversity, the remaining quadrats were classified as very low diversity. Q31 emerged as the most diverse quadrat since it has the most number of species among the quadrats. However, it should be noted that this quadrat was located in a protected forest area thus contains more species compared with the other quadrats. Similarly, Simpson's Index and Evenness Index are highest in Q34 because no species is dominating over the area. Q26 (not shown in the table) provided the lowest value for the two indices (H' and D) because the quadrat has only 2 species and is exploited for growing *Falcata* which dominates the area.

Analysis of the stream sections of Cabadbaran River shows the same relative diversity values ranging from "low" to "very low" (Table 3). The additional quadrats located on the forests of the headwaters which is part of the protected area was computed to have a higher diversity value ("moderate"), yet the overall composite diversity index of the whole river is still on the "low" range only. The forests on the headwaters are at risk for deterioration due to the ongoing road construction connecting the provinces of Agusan del Norte and Surigao del Norte as road constructions increase fragmentation of habitats, influences landscape pattern and alters the physical environment (Vaiškūnaitė et al. 2012).

The low to the very low classification of most quadrats can be attributed to the conversion of riparian areas into agriculture and forestry plantation purposes. Most surveyed quadrats were opened, cleared, or have been newly established for growing *Falcata* and Corn (*Zea mays*). In addition, huge areas in the midstream section were affected by forest fires in July 2021. Steep slope vegetations, grassland areas, and *Falcata* plantations were totally wiped out (Fig. 4).

Cluster Analysis

Using PAST 4.03 updated software, the hierarchical clustering of quadrats based on the species composition and species abundance of each sampling transect were generated (Fig. 5). The figure shows the Bray-Curtis Similarity Index as percentage similarities among sampling quadrats. Five major clusters were formed and the majority of the quadrats especially those located in the lower elevations have very similar species composition (mostly Falcata), the other 4 cluster combinations have very low similarity (few species in common). This implies that in terms of species composition, each quadrat has its unique floral characteristics and/or is very different from the other quadrats. The most similar quadrats are Q13 and Q24 with almost 95% similarity. These two quadrats have two species in common and both are dominated by Falcata (*F. moluccana*).

The information can assist decision makers and planners on the development of the particular areas where the quadrats were located. For instance, conversion of Q13 for other purposes will not significantly affect the overall diversity of the area since most of its species are also found in Q24. This implies that similar management strategies can be applied to related quadrat/habitats, however, it is always more important to consider the biological value of the species in the area, rather than their similarities (Malabrigo *et al.*, 2014).

Overall Species Diversity

The complete listing of the different plant families and species for the sample plots as well as those encountered in the line transect are listed in (Table 4). A total of 109 morpho-species belonging to 46 families and 88 genera were recorded and identified from the study area. The highest number of species was found in the family Moraceae with 13 species, followed by Fabaceae (12 species), and Dipterocarpaceae (8 species). Tree species of the family Moraceae, Fabaceae, and Rubiaceae dominates the lower elevations (50 - 150 masl) surveyed while in higher elevation of 150-250 masl, woody species of Dipterocarpaceae and Myrtaceae were identified and naturally growing in the undisturbed area where the plots were established.

Based on growth habits, 74% were classified as trees and shrubs comprising majority of the species identified in the study area. Grasses and grass-like plants followed as 8%, and the other ground dwelling herbs as 5% of the total species (Fig. 6).

The geographical distribution of plant species has been very useful for assessing biodiversity values of regions, countries, and islands. Species confined to a particular site should be given particular conservation management strategies as they are more vulnerable to disturbance due to their narrow range (Malabrigo 2013). The figure below (Fig. 7) shows the distribution of plant species based on endemism (Pelser et al. 2011).

Threatened Species

Nineteen species recorded from the area are listed under either the Philippine Red List (Fernando et al. 2008) or the IUCN Red List of Threatened Species (IUCN 2021) (Table 5). Noteworthy among the list is the critically endangered (CR) premium timber species including seven Dipterocarps (*Dipterocarpus gracilis, Hopea mindanensis, Parashorea malaanonan, Shorea almon, S. contorta, S. negrosensis, and S. polysperma*) and the superior hardwood Narra (*Pterocarpus indicus* Willd.). The tree fern species, Pakong buwaya (*Cyathea contaminans* (Wall.) Copel.) was listed in the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES 2021).

Conclusions

The Cabadbaran River Watershed Forest Reserve is one of the primary sources of irrigation water in Agusan del Norte. However, with decades of providing irrigation water, the local irrigation office recorded a declining water yield for irrigation purposes. This can be the result of the massive disturbance happening in the watershed especially along the riparian areas. With the results of this assessment, the majority of the riparian areas were determined to have “low” to “very low” diversity values. The three sections surveyed were found out to have very similar species composition. And recently, a large portion of the riparian areas were even damaged due to forest fires caused by illegal farming practices.

The area covered by this survey is only a small fraction but the most integral section of the CRWFR. Only a few ecologically important species were recorded and all of them are found only in the headwater forest. With the ongoing road construction in the protected area, there is no doubt that in the near future, the fate of this ecologically important species will be at risk similar to the rampant conversion happening in the riparian areas of the main Cabadbaran River channel.

The information generated by this study will better guide the stakeholders in the formulation of an irrigation water management plan that should complement and enhance the already existing integrated watershed management plan of Agusan del Norte in the proper management and conservation of the Cabadbaran River Watershed Forest Reserve.

Acknowledgements

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Conflicts of interest

The authors declare that there is no conflict of interest.

References

- Burton ML, Samuelson LJ (2008) Influence of urbanization on riparian forest diversity and structure in the Georgia Piedmont, US. Plant Ecology 195: 99-115.
- Buzarboruah PD (2014) Rivers and the Assamese folk life: A right relationship of man and nature. Journal of Social Sciences, Arts and Humanities 2 (2): 33-4.
- CITES (2021) Convention on International Trade in Endangered Species of Wild Fauna and Flora: Appendices I, II, and III. https://cites.org/eng/app/appendices.php. Accessed on: 2022-2-25.
- DENR-FMB (2013) Philippine Forests Facts and Figures. https://forestry.denr.gov.ph/pdf/ref/PF3_2013.pdf. Accessed on: 2022-2-25.
- Fernando ES, Balatibat JB, Peras JR, Jumawid RRJ (1998) Resource inventory and assessment of biodiversity in the Subic Bay Metropolitan Authority. Report. URL: https://agris.fao.org/agris-search/search.do?recordID=PH2000100547
- Fernando ES, Co LC, Lagunzad DA, Gruezo WS, Barcelona JF, Madulid DA, Lapis AB, Texon GI, Manila AC, Zamora PM (2008) Threatened plants of the Philippines: A preliminary assessment. Asia Life Science Supplement 3: 1-52.
- IUCN (2021) IUCN Red List of Threatened Species. Version 2021-2. https://www.iucnredlist.org. Accessed on: 2022-2-25.
- Maciukenaite J, Povilaitienė I (2013) The Role of the River in the City Centre and its Identity. Journal of Sustainable Architecture and Civil Engineering 4 (5): 33-41.
- Malabrigo PLJ (2013) Plant biodiversity assessment of Agno River in San Roque Watershed, Pangasinan. Unpublished Report.
- Malabrigo PLJ, Umali AGA, Elec JP (2014) Riparian flora of Kaliwa River Watershed in the Sierra Madre Mountain Range, Philippines. Ecosystems & Development Journal 5 (1): 11-22.
- Naiman RJ, De·Camps H (1997) The ecology of in-terfaces: Riparian zones. Annual Review of Ecology and Systematics 28: 621-658.
- Ozigis II, Oodo SO, Muhammad ID (2019) A feasibility study of mini-hydroelectric power plant for seasonal base load. Arid Journal of Engineering, Technology and Environment 15 (Sp.i2): 124-145.
- Pelser PB, Barcelona JF, Nickrent DL (2011) Co's Digital Flora of the Philippines. www.philippineplants.org. Accessed on: 2022-2-25.
- Philippines (1991) Official Gazette (Republic of the Philippines). https://www.officialgazette.gov.ph/1991/11/13/proclamation-no-834-s-1991/. Accessed on: 2022-2-25.
- Rojo JP (1999) Revised lexicon of Philippine trees. Forest Product Research and Development Institute, Department of Science and Technology, College, Laguna, Philippines, 84 pp.

- Sankhwal AO, Shah SD, Gavali DJ, Dudani SN (2015) Riparian flora of Mahi River, Gujarat. Biolife 3 (4): 820-826. https://doi.org/10.17812/blj.2015.3412
- Tochner K, Ward JV (1999) Biodiversity along riparian corridors. Archiv für Hydrobiologie – Supplements 115 (3): 293-310.
- Vaiškūnaitė R, Mierauskas P, Špakauskas V (2012) Biodiversity impact assessment in road development in Lithuania. Transport 22 (2): 187-195. https://doi.org/10.3846/16484142.2012.695749
- WFO (2022) World Flora Online. http://www.worldfloraonline.org. Accessed on: 2022-2-25.
- Zaimes GN (2020) Mediterranean riparian areas-climate change implications and recommendations. Journal of Environmental Biology 41: 957-965.

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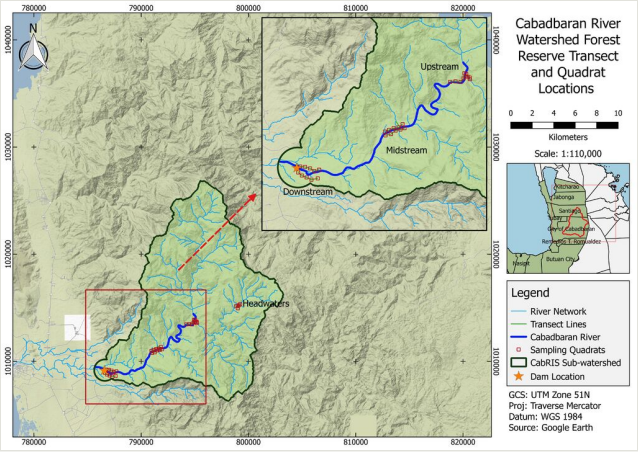

Figure 1.

Location map of the different sampling quadrats along Cabadbaran River.

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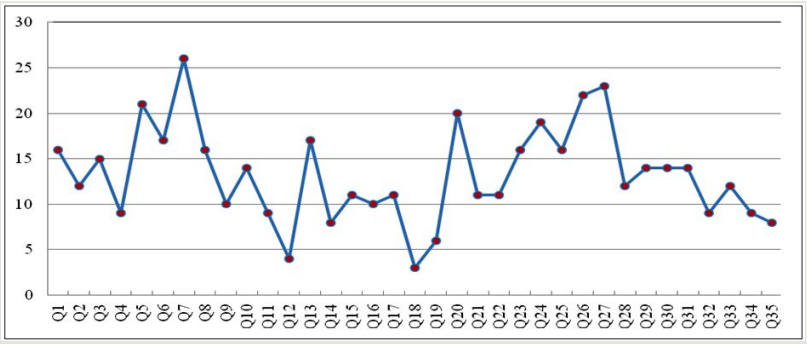

Figure 2.

Number of individuals per sampling quadrat

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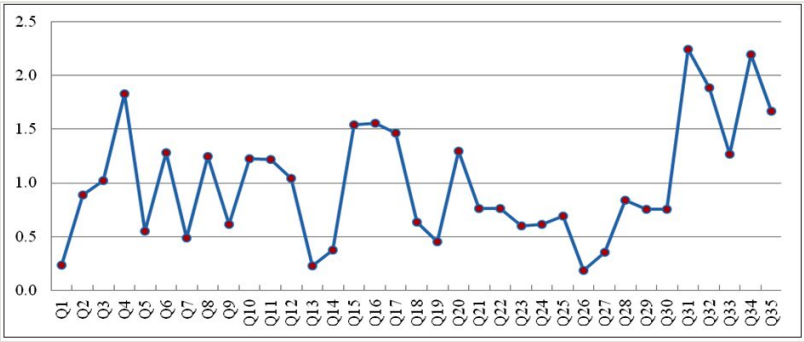

Figure 3.

Computed Shannon's Diversity Index (H) of the sampling quadrats

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Figure 4.

(Left) Areas in the riparian zone cleared for agricultural purposes, (Right) View of forest fire damage in the mountainous areas of the watershed.

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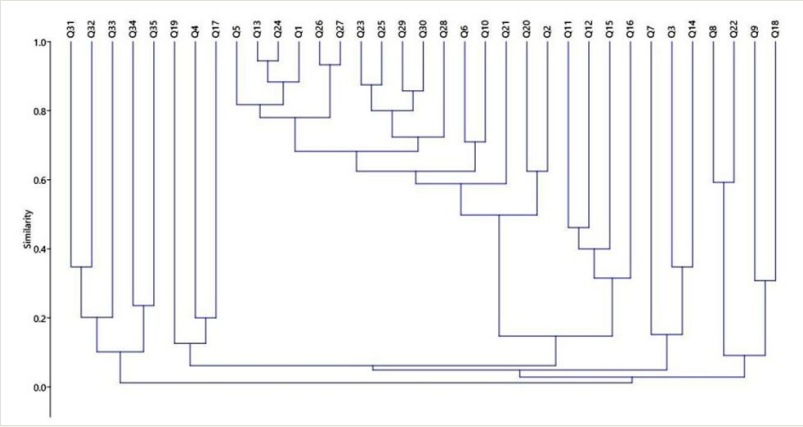

Figure 5.

Bray-Curtis Cluster Analysis of sampled quadrats.

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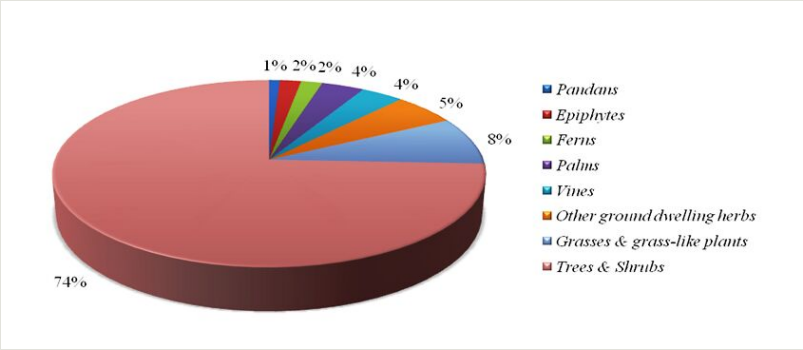

Figure 6.

Classification of plant species into groups based on their growth habit

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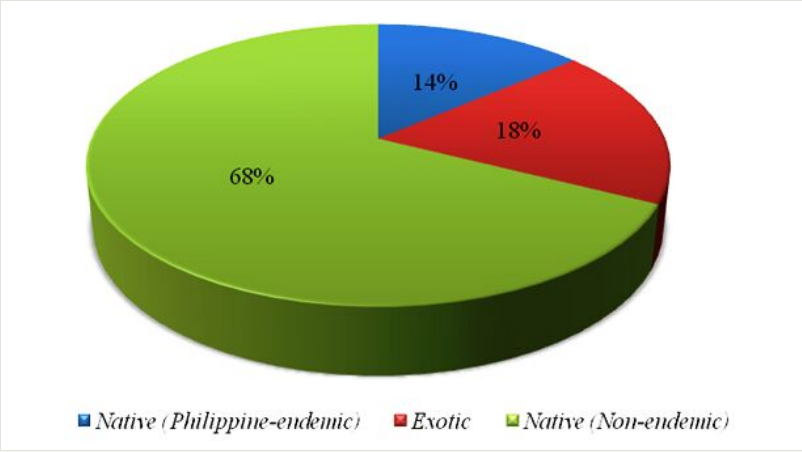

Figure 7.

Classification of plant species with reference to their ecological distribution.

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Table 1.

Top ten species with the highest Species Importance Values (SIV).

Species	R. Frequency	R. Dominance	R. Density	SIV
Falcata	13.01	44.95	24.99	82.95
White Lauan	2.74	1.29	22.35	26.38
Coconut	6.16	9.46	8.96	24.59
Antipolo	8.22	4.73	2.75	15.70
Lapnis	6.16	3.87	1.60	11.63
Ipil-ipil	3.42	4.52	1.78	9.72
Bagtikan	2.05	0.65	6.50	9.20
Prickly Narra	4.11	2.15	2.14	8.40
Kakawate	2.74	3.44	1.73	7.91
Panau	2.05	1.72	3.67	7.44

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Table 2.

Top Ten quadrats with the highest diversity indices and the number of species.

Quadrat	Shannon's	Simpson's	Evenness	Number of Species	Relative Values
Q 31	2.243	0.888	0.942	10	Low
Q 34	2.197	0.889	1.000	9	Low
Q 32	1.889	0.840	0.945	7	Very Low
Q 4	1.831	0.815	0.892	7	Very Low
Q 35	1.667	0.781	0.883	6	Very Low
Q 16	1.557	0.780	0.949	5	Very Low
Q 15	1.540	0.727	0.778	6	Very Low
Q 17	1.468	0.744	0.868	5	Very Low
Q 20	1.297	0.705	0.914	4	Very Low
Q 6	1.282	0.561	0.515	7	Very Low

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Table 3.

Summary of diversity indices per section of Cabadbaran River.

Stream Section	Shannon's Index (H')	Evenness	Relative Values
Downstream	2.099	0.3884	Low
Midstream	2.298	0.6222	Low
Upstream	1.028	0.1864	Very Low
Headwaters	2.967	0.7770	Moderate
Riparian Total	2.491	0.2277	Low

Table 4.

List of species encountered in the quadrats and transects.

Family	*Scientific Name*	*Common Name*	*Growth Habit*	*Endemicity*
Anacardiaceae	*Mangifera indica*	Mangga	T&S	Native (NE)
Annonaceae	*Annona muricata*	Guyabano	T&S	Native (NE)
Annonaceae	*Cananga odorata*	Ilang-ilang	T&S	Native (NE)
Araceae	*Colocasia esculenta*	Gabi	OGDH	Native (NE)
Araliaceae	*Polyscias nodosa*	Malapapaya	T&S	Native (NE)
Arecaceae	*Areca catechu*	Bunga	PC&P	Native (NE)
Arecaceae	*Arenga pinnata*	Kaong	PC&P	Native (NE)
Arecaceae	*Caryota mitis*	Pugahan	PC&P	Native (PE)
Arecaceae	*Cocos nucifera*	Niyog	PC&P	Native (NE)
Aspleniaceae	*Asplenium nidus*	Bird's Nest Fern	E	Native (NE)
Asteraceae	*Chromolaena odorata*	Hagonoy	G&GLP	Native (NE)
Burseraceae	*Canarium ovatum*	Pili	T&S	Native (PE)
Byttneriaceae	*Kleinhovia hospita*	Tan-ag	T&S	Native (NE)
Byttneriaceae	*Theobroma cacao*	Cacao	T&S	Exotic
Cannabaceae	*Trema orientalis*	Anabiong	T&S	Native (NE)
Caricaceae	*Carica papaya*	Papaya	OGDH	Exotic
Casuarinaceae	*Casuarina equisetifolia*	Agoho	T&S	Native (NE)
Combretaceae	*Terminalia catappa*	Talisai	T&S	Native (NE)
Convolvulaceae	*Merremia peltata*	Bulakan	T&S	Native (NE)
Cyatheaceae	*Cyathea contaminans*	Tree fern	F	Native (NE)
Cyperaceae	*Cyperus flabelliformis*	Umbrella grass	G&GLP	Native (NE)
Datiscaceae	*Octomeles sumatrana*	Binuang	T&S	Native (NE)
Dennstaedtiaceae	*Pteridium aquilinum*	Bracken Fern	F	Native (NE)
Dilleniaceae	*Tetracera scandens*	Katmon-baging	T&S	Native (NE)
Dipterocarpaceae	*Dipterocarpus gracilis*	Panau	T&S	Native (NE)
Dipterocarpaceae	*Hopea mindanensis*	Yakal-magasusu	T&S	Native (PE)
Dipterocarpaceae	*Parashorea malaanonan*	Bagtikan	T&S	Native (NE)
Dipterocarpaceae	*Shorea almon*	Almon	T&S	Native (NE)
Dipterocarpaceae	*Shorea assamica*	Manggasinoro	T&S	Native (NE)
Dipterocarpaceae	*Shorea contorta*	White Lauan	T&S	Native (PE)
Dipterocarpaceae	*Shorea negrosensis*	Red Lauan	T&S	Native (PE)
Dipterocarpaceae	*Shorea polysperma*	Tanguile	T&S	Native (NE)
Euphorbiaceae	*Endospermum peltatum*	Bay-ang	T&S	Native (NE)
Euphorbiaceae	*Macaranga tanarius*	Binunga	T&S	Native (NE)

Euphorbiaceae	*Manihot esculenta*	Kamoteng-kahoy	T&S	Exotic
Fabaceae	*Acacia auricauliformis*	Auri	T&S	Exotic
Fabaceae	*Acacia mangium*	Mangium	T&S	Exotic
Fabaceae	*Albizia saman*	Rain Tree	T&S	Native (NE)
Fabaceae	*Bauhinia integrifolia*	Agpoi	T&S	Native (NE)
Fabaceae	*Falcataria moluccana*	Falcata	T&S	Exotic
Fabaceae	*Gliricidia sepium*	Kakawate	T&S	Native (NE)
Fabaceae	*Inocarpus fagifer*	Kayam	T&S	Native (NE)
Fabaceae	*Leucaena leucocephala*	Ipil-ipil	T&S	Exotic
Fabaceae	*Mimosa pudica*	Makahiya	G&GLP	Native (NE)
Fabaceae	*Pongamia pinnata*	Bani	T&S	Native (NE)
Fabaceae	*Pterocarpus indicus*	Narra (Smooth)	T&S	Native (NE)
Fabaceae	*Pterocarpus indicus f. echinatus*	Narra (Prickly)	T&S	Native (NE)
Fabaceae	*Senna alata*	Akapulko	T&S	Native (NE)
Fagaceae	*Lithocarpus celebicus*	Ulaian	T&S	Native (NE)
Gentianaceae	*Fagraea racemosa*	Balat buaya		Native (NE)
Graminae	*Bambusa bambos*	Kauayan-tinik	G&GLP	Native (NE)
Graminae	*Gigantochloa levis*	Bolo	G&GLP	Native (NE)
Hypericaceae	*Cratoxylum formosum*	Salingogon	T&S	Native (NE)
Hypericaceae	*Cratoxylum sumatranum*	Paguringon	T&S	Native (NE)
Lamiaceae	*Gmelina arborea*	Gmelina	T&S	Exotic
Lamiaceae	*Premna odorata*	Alagau	T&S	Native (NE)
Lauraceae	*Persea americana*	Avocado	T&S	Exotic
Lythraceae	*Lagerstroemia piriformis*	Batitinan	T&S	Native (NE)
Malvaceae	*Pterospermum acerifolium*	Bayog	T&S	Native (NE)
Malvaceae	*Sterculia foetida*	Kalumpang	T&S	Native (NE)
Marantaceae	*Donax canniformis*	Banban	OGDH	Native (NE)
Melastomataceae	*Melastoma malabathricum*	Malatungaw	T&S	Native (NE)
Meliaceae	*Azadirachta indica*	Neem	T&S	Native (NE)
Meliaceae	*Dysoxylum gaudichaudianum*	Igiu	T&S	Native (NE)
Meliaceae	*Sandoricum koetjapi*	Santol	T&S	Native (NE)
Menispermaceae	*Arcangelisia flava*	Panyawan	T&S	Native (NE)
Moraceae	*Artocarpus altilis*	Rimas	T&S	Native (NE)
Moraceae	*Artocarpus blancoi*	Antipolo	T&S	Native (PE)
Moraceae	*Artocarpus camansi*	Kamansi	T&S	Native (NE)
Moraceae	*Artocarpus heterophyllus*	Nangka	T&S	Native (NE)
Moraceae	*Artocarpus odoratissimus*	Marang bangohan	T&S	Native (NE)

Moraceae	*Broussonetia papyrifera*	Lapnis	T&S	Exotic
Moraceae	*Ficus balete*	Balete	T&S	Native (PE)
Moraceae	*Ficus benjamina*	Baliteng salisi	T&S	Native (NE)
Moraceae	*Ficus congesta*	Malatibig	T&S	Native (NE)
Moraceae	*Ficus minahassae*	Hagimit	T&S	Native (NE)
Moraceae	*Ficus nota*	Tibig	T&S	Native (NE)
Moraceae	*Ficus pseudopalma*	Niyog-niyogan	T&S	Native (PE)
Moraceae	*Ficus septica*	Hauili	T&S	Native (NE)
Moraceae	*Ficus ulmifolia*	Is-is	T&S	Native (PE)
Moraceae	*Neonauclea formicaria*	Hambabawud	T&S	Native (NE)
Muntigiaceae	*Muntingia calabura*	Datiles	T&S	Native (NE)
Musaceae	*Musa × paradisiaca*	Banana	OGDH	Native (NE)
Musaceae	*Musa acuminata*	Agutay	OGDH	Native (PE)
Musaceae	*Musa textilis*	Abaca	OGDH	Native (NE)
Myrtaceae	*Eucalyptus deglupta*	Bagras	T&S	Native (NE)
Myrtaceae	*Leptospermum javanicum*	Payuspos	T&S	Native (NE)
Myrtaceae	*Psidium guajava*	Bayabas	T&S	Exotic
Myrtaceae	*Syzygium malaccense*	Makopa	T&S	Native (NE)
Myrtaceae	*Xanthostemon verdugonianus*	Mankono	T&S	Native (PE)
Oxalidaceae	*Averrhoa bilimbi*	Iba	T&S	Native (NE)
Pandanaceae	*Pandanus copelandii*	Bariu	PC&P	Native (PE)
Phyllanthaceae	*Bischofia javanica*	Tuai	T&S	Native (NE)
Phyllanthaceae	*Flueggea flexuosa*	Anislag	T&S	Native (NE)
Poaceae	*Eleusine indica*	Paragis	G&GLP	Native (NE)
Poaceae	*Imperata cylindrica*	Cogon	G&GLP	Native (NE)
Poaceae	*Saccharum spontaneum*	Talahib	G&GLP	Native (NE)
Poaceae	*Zea mayz*	Mais	G&GLP	Native (NE)
Polypodiaceae	*Drynaria quercifolia*	Kabkab	E	Native (NE)
Rubiaceae	*Mussaenda philippica*	Kahoy-dalaga	T&S	Native (PE)
Rubiaceae	*Nauclea orientalis*	Bangkal	T&S	Native (NE)
Rubiaceae	*Neonauclea bartlingii*	Lisak	T&S	Native (PE)
Rubiaceae	*Neonauclea media*	Wisak	T&S	Native (PE)
Sapotaceae	*Chrysophyllum cainito*	Caimito	T&S	Exotic
Sapotaceae	*Palaquium pinnatinervium*	Tagkan	T&S	Native (PE)
Sapotaceae	*Pouteria macrantha*	Red Nato	T&S	Native (NE)
Solanaceae	*Capsicum annuum*	Sili	T&S	Exotic
Solanaceae	*Solanum torvum*	Talong-talongan	T&S	Native (NE)

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Urticaceae	*Dendrocnide meyeniana*	Alingatong	T&S	Native (NE)
Urticaceae	*Leucosyke capitellata*	Alagasi	T&S	Native (NE)

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Table 5.

List of threatened species recorded in the study area.

Scientific Name	Family	Philippine Red List	IUCN Red List
Artocarpus odoratissimus	Moraceae	-	NT
Asplenium nidus	Aspleniaceae	VU	-
Canarium ovatum	Burseraceae	OTS	-
Cyathea contaminans	Cyatheaceae	VU	-
Dipterocarpus gracilis	Dipterocarpaceae	VU	VU
Drynaria quercifolia	Polypodiaceae	VU	-
Eucalyptus deglupta	Myrtaceae	-	VU
Ficus ulmifolia	Moraceae	-	VU
Flueggea flexuosa	Phyllanthaceae	VU	-
Hopea mindanensis	Dipterocarpaceae	CR	EN
Palaquium luzoniense	Sapotaceae	-	VU
Palaquium pinnatinervium	Sapotaceae	-	EN
Parashorea malaanonan	Dipterocarpaceae	-	CR
Pterocarpus indicus	Fabaceae	CR	VU
Shorea almon	Dipterocarpaceae	VU	NT
Shorea contorta	Dipterocarpaceae	VU	-
Shorea negrosensis	Dipterocarpaceae	VU	-
Shorea polysperma	Dipterocarpaceae	VU	-
Xanthostemon verdugonianus	Myrtaceae	EN	VU