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Woody plant composition along Ulot River, Samar Island Natural Park, Philippines: Community uses and conservation concerns

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Abstract. *Buhay AFV, Banaticla-Hilario MCN, Buot Jr IE, Napaldet JT, Masungsong L, Origenes M, Hilvano N, Echapare E, Balindo DS. 2025. Woody plant composition along Ulot River, Samar Island Natural Park, Philippines: Community uses and conservation concerns. Biodiversitas 26: 3081-3103.* A comprehensive woody plants inventory is crucial for local governments and agencies to determine useful plant species and develop effective conservation policies. This study enumerates woody plant species in the Ulot riparian forest of Samar Island Natural Park (SINP), Philippines. A total of 574 individual plants, comprising 153 species from 46 families, were documented. There are 112 species classified as trees, six as shrubs, 20 that can be shrubs or small trees, one vine species, 10 palm species, and one grass species. The recorded 43 Philippine endemics and 39 threatened species emphasize the unique riparian flora of Ulot River. Economic uses and seed storage behavior were also assessed through literature and database review. Local communities utilized plant species in the Ulot riparian zone for economic purposes like food (21 species), medicine (61 species), fuelwood (21 species), timber (64 species), landscaping (8 species), dyes/tannins (8 species), and rope-making (4 species), as well as for cultural uses, including ornamentals (15 species), landscaping (8 species), and mastication (2 species). Several species, such as *Aquilaria cumingiana*, dipterocarps and *Syzygium* species, are noted to be endemic and have economically important uses. Based on these findings, a conservation framework is proposed that balances sustainable resource use and conservation measures in Samar Island riparian zones. It integrates environmental policies, awareness, and ecotourism while supporting in situ and ex situ conservation, including seed banking and habitat restoration. These strategies are critical in ensuring ecological stability and in local environmental policy-making.

Keywords: Conservation, plant diversity, riparian ecosystem, Samar Island Natural Park, Ulot River

INTRODUCTION

Riparian zones are unique ecosystems located between the terrestrial and aquatic areas, often found along riverbanks. These areas support high biodiversity, including plants, animals, and microbes (Glass and Floyd 2015; Fu et al. 2016; Ledesma et al. 2018). Vegetation in these zones is a core component, with species distributed from higher elevation down to the river channels (Leyer 2005). The physical characteristics of riparian zones physically vary across regions and topography, which can lead to seasonal complexities, particularly in typhoon-prone areas like Samar Island, Philippines (Ramey and Richardson 2017).

Riparian ecosystems, serves as crucial habitats and biological corridors, facilitating ecological connectivity and supporting biodiversity both terrestrial and aquatic life (Riis et al. 2020; Fonseca et al. 2021). These helps regulate water quality, prevent soil erosion, and buffer the impacts of flooding and other disturbances (Feld et al. 2018; Sosa et al. 2018; Gay et al. 2022). However, human activities, such as urbanization, dam construction, quarrying, and agriculture, pose serious threats, leading to habitat destruction, water pollution, and biodiversity loss (Alho et al. 2015; Driscoll et al. 2019; Lohani et al. 2020; Grabowski et al. 2022).

Samar Island Natural Park (SINP), Philippines, is a critical biodiversity hotspot, hosting a high diversity of endemic and endangered plant and animal species, including ferns, lycophytes, medicinal plants, and newly described species, (Pinarok et al. 2015; Tolentino et al. 2020; Obeña et al. 2021; Villanueva et al. 2021a, b, 2023; delos Angeles et al. 2022a, b, 2023; Tandang et al. 2022; Buot Jr et al. 2024; Origenes and Buot Jr 2024). The Ulot River in SINP is an important resource for the local community, providing water for domestic and agricultural use and attracts tourism through river rafting, cliff jumping and ecotours, (Orale 2014), which generate income for residents. The forested riparian zones maintain water flow, improve quality, support plant diversity, and ensure soil fertility (Mello et al. 2017; Hilary et al. 2021).

Despite ecological richness, the area faces threats from expanding human settlements and agriculture. These increases forest fragmentation and land use pressure, disruption of natural systems causing soil erosion and reducing habitat connectivity (Buhay et al. 2023). These conditions heighten the Ulot River's vulnerability to environmental degradation, which in turn threatens the ecosystem services and livelihood it supports. Previous studies in SINP focused on general biodiversity, few explored the floristic composition of riparian zones. This study addresses that gap by providing a woody plant inventory, essential for conservation planning and disaster risk reduction. A floristic assessment helps evaluate ecological condition and identify plant species that require conservation priority. Species at high risk of extinction must be included in conservation priority lists, and one effective strategy is their inclusion in nursery propagation projects. Understanding their seed storage behavior can further facilitate and improve conservation efforts. Seed storage behavior is critical in the conservation of plant species, especially those considered endangered or have been identified to have high economic importance. This information ensures the formulation of efficient ex situ conservation measures like seed banking to maintain genetic variability and facilitate the restoration of deforested areas. Seed banking is an economically viable approach that ensures the preservation of plant genetic resources, for instance, of species under stress from the environment or habitat destruction (Mayrinck et al. 2019; Singh et al. 2021). Moreover, knowledge of seed storage behavior guides the choice of suitable storage conditions and methods to ensure seed viability in the long term. This is especially important for species found in biodiversity hotspots and those that are difficult to conserve in their natural environments (de Vitis et al. 2020; Wolkis et al. 2020).

Effective conservation of these species strengthens the resilience of riparian zones, enabling them to continue providing critical ecosystem services, such as flood regulation, erosion control, water purification, and habitat provision. These services are essential for minimizing disaster risks and sustaining local livelihoods.

This paper focused on documenting the woody plant biodiversity in the riparian zone of Ulot River in SINP. Specifically, the study aimed to: i) enumerate the woody plant species composition in the upstream, midstream and downstream of the riparian zone of Ulot River; ii) determine the economic and cultural uses, conservation status as well as the seed storage behavior of the floristic elements; iii) summarize and compare the distribution of plant use categories across different land use types within the Ulot riparian zone using descriptive statistical methods; iv) develop a conservation framework for a sustainable management of woody plant species in Ulot River riparian zone. By providing ecological data, this study contributes to conservation planning and sustainable land management in SINP.

MATERIALS AND METHODS

Study area

The study was conducted in the riparian zone of the Ulot River in the municipalities of Paranas, Samat and Can-avid, Eastern Samar at approximately, 11°50′58.21″ N and 125°11′39.53″ E with an elevation ranging from 18 to 82 m asl (Figure 1). Geographic Information System was employed to map the locations of study plots situated along the riparian zones of the Ulot River, encompassing various land use types, including open forests, shrublands, and perennial agricultural lands. A total of 18 plots, were established in the upstream, midstream, and downstream sections of the Ulot River, located within the boundaries of the Samar Island Natural Park (SINP), Philippines.

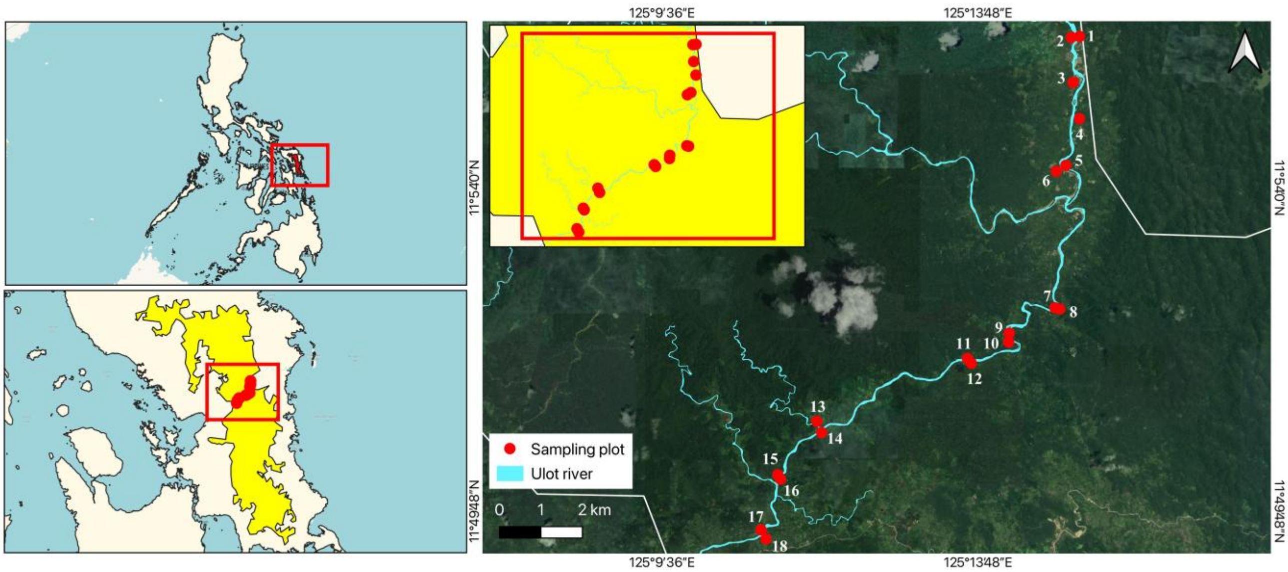

Figure 1. Location of Ulot River, Samar Island Natural Park, Philippines, indicating the sampling sites. 1-6: Downstream, 7-12: Midstream, 13-18: Upstream (Source: NAMRIA; Generated from QGIS 3.30)

Each subsection of the river covered 8 kilometers, accordingly the total length of the river of interest stretched approximately 24 kilometers within SINP. Each plot spaced 2 to 2.5 kilometers apart. The interval ensured adequate spatial representation along the 24-kilometer stretch of the Ulot River within SINP. This spacing strategy allowed researchers to capture the variability in vegetation communities influenced by land use, topography, and hydrological gradients, which were key principles in landscape-scale ecological monitoring (USGS 2007). The river stratification into three sections and the assignment of six plots to each section further enhanced the study's ability to detect longitudinal patterns and gradients in riparian vegetation. This approach was supported by studies emphasizing the importance of stratified and longitudinal sampling in riparian zones for capturing spatial heterogeneity and ecological processes (Heartsill-Scalley and Crowl 2021; Wang et al. 2021; Torgersen et al. 2022). Furthermore, the number of plots aligned with similar ecological studies in tropical riparian zones, where logistical constraints often limit extensive sampling, but strategic spacing and stratification yielded statistically meaningful results (Sarmiento et al. 2022). The total area sampled (1,800 m² or 0.18 hectares) provided a practical compromise between spatial coverage and fieldwork feasibility, which ensured an overview of riparian species composition and structure without overextending resources.

Procedures

The quadrat method was used to analyze the riparian vegetation, with each quadrat measuring 10x10 m, in various land use types (open forest, shrubland and perennial lands) along the river's main channel. Plants within the quadrats were identified, sampled, and labeled. Selected specimens were collected and preserved as herbarium samples for further study. These specimens were then deposited at the Plant Biology Division Herbarium (PBDH) of the Institute of Biological Sciences, University of the Philippines Los Baños.

Data collection

Information on how each plant species is used was gathered from literature reviews, scientific articles, books, and informal interviews with locals in the riparian zone. Sources such as Enumeration of Philippine Flowering Plants (Merrill 1925) and Co's Digital Flora of the Philippines (www.philippineplants.org). Plant uses were checked from Global Biodiversity Information Facility, GBIF (http://www.gbif.org/) at stuartxchange (https://www.stuartxchange.org/), Asian Plant Name Website (https://asianplant.net/), World Flora Online Website (https://www.worldfloraonline.org/), and other scholarly articles.

Conservation status of each species was evaluated and labeled as: Critically Endangered (CR), Endangered (EN), Vulnerable (VU), Near Threatened (NT), Other Threatened Species (OTS), Least Concern (LC), Data Deficient (DD) and Not Evaluated (NE). The evaluation was done in both local and global perspectives. The Department of Environment and Natural Resources (DENR) Administrative Order No. 11 of 2017 (DAO 2017-11 2017) or The National List of Threatened Philippine Plants and their Categories, as reference for local conservation status. For global conservation status, The International Union for Conservation of Nature's (IUCN) Red List of Threatened Species (www.iucnredlist.org/) was consulted. The IUCN Red List is the leading global reference for evaluating the conservation status of plant species. Seed storage behavior was searched at Seed Information Database (https://ser-sid.org/), an open-access website hosted by the Society for Ecological Restoration in collaboration with the Royal Botanic Gardens Kew. This database provides an information on seed traits, including viability, dormancy, and storage requirements, which are crucial for conservation planning and seed banking initiatives.

Data analysis

In this study, descriptive statistical methods were employed to summarize and interpret data on woody plant uses within the Ulot riparian zone. Key measures such as frequency distributions and summary counts were calculated to categorize plants based on their reported uses (e.g., medicinal, food, ornamental, construction etc.). Data were grouped by land use types (open forests, shrublands, and perennial agricultural lands) to facilitate comparisons of plant use patterns across different riparian sections. Crosstabulation and visual tools, including bar charts, were used to present the distribution and prevalence of plant use categories. All statistical analyses were performed using Microsoft Excel and PAST 4.03 software.

RESULTS AND DISCUSSION

Floristic composition

A total of 574 individuals of vascular plant species, representing 153 species and 46 families were documented (Table 1). The most speciose families across the three sections of the Ulot River were Moraceae with 15 species, followed by Rubiaceae with 12 species, and Arecaceae, Malvaceae, and Phyllanthaceae with 10 species each. The most abundant families in terms of number of individuals across all species, were Moraceae with 60 individuals, Malvaceae with 56 individuals and Euphorbiaceae with 47. The most species-rich genera were *Ficus* with 13 species followed by *Shorea* and *Syzygium* represented by 5 species each.

In terms of plant habit, the checklist comprised 112 species characterized as trees, six species as shrubs, 20 species as either shrubs or small trees, 1 vine species, 10 palm species, and one grass species, all contributing to the overall biodiversity in the Ulot riparian zones. Knowing the growth habits of plants growing along the Ulot River helped understand the overall structure and function of the Ulot riparian ecosystems. The dominance of tree species suggested a well-established forest ecosystem that provided essential ecological functions such as soil stabilization, water filtration, and habitat for wildlife (Passion et al. 2020; Kinnoumè et al. 2024). Shrubs and small trees, particularly those from families like Moraceae and Euphorbiaceae, contributed to the understory layer and were frequently used for medicinal and food purposes. Their presence not only supported species diversity by offering habitat and resources but also reflected the importance of understory vegetation in local use patterns. (Forio et al. 2020; Biță-Nicolae et al. 2024). Palms, especially from the Aceraceae family with their distinctive growth forms, contributed to both canopy diversity and resource availability for nesting sites for birds (Li et al. 2023). The presence of a single grass and climber, though limited, indicated the adaptability of certain species to the riparian environment. Understanding these growth habits aided in assessing the resilience and health of the ecosystem, informing conservation and management efforts.

The distribution of families across three river section varied with each land use patterns (Figure 2). The upstream had the greatest variability and the highest median values, with data ranging from near zero up to about 34. The Interquartile Range (IQR) extended from around 1 to 18, indicating a wide spread of number of individual species represented in each family. This section was mostly shrubland but also included areas of perennial and open forest, which may have contributed to the high variability. The midstream showed a more compact distribution, with a median around 2 and an IQR between roughly 1 and 5. Its values ranged up to about 16, suggesting lower variability compared to Upstream. The land in this section was mainly open forest, with some shrubland and perennial land, which likely led to the more moderate and consistent values. The downstream had a median and IQR similar to midstream, but its range extended up to about 33, indicating some higher outliers. This area was mostly covered by perennial land, along with some shrubland and open forest. The land use type may have resulted in more clustered values, while occasional changes in land use might have caused the wider range. Overall, the differences in land use types across the river sections were reflected in the variation and patterns seen in the data.

The species accumulation curve showed a clear pattern of species richness across 18 riparian vegetation plots (Figure 3). Cumulative richness rose sharply from 17 to 102 species between Plot 1 and Plot 7. Early plots captured much of the community's variation, indicating strong spatial turnover. Species accumulation slowed from Plot 8 onward. Between Plots 8 and 13, richness rose from 111 to 129, showing fewer new species added. This phase suggested increased redundancy, as plots shared more species. By Plot 13, the curve plateaued, with no gain between Plots 12 and 13, indicating a sampling saturation point. From Plots 14 to 18, the curve rose slightly, reaching 154 species. These minor gains likely reflected the change of land cover in the area. The curve showed that sampling was sufficient to capture most species in the Ulot riparian zone. It highlighted the woody plant spatial structure and variation along the river. The trend suggested that richness was influenced by both anthropogenic activities, local conditions, and broader spatial turnover.

Local uses, endemicity and conservation status

This study distinguished itself among Philippine riparian assessments through its extensive taxonomic inventory of 153 species and its in-depth analysis of the economic and cultural significance of vegetation, features often underexplored in similar research. Unlike the other sites vegetation studies on riparian zones (Muleta and Angono), the Ulot River lay within the boundaries of the SINP, a legally protected area, which emphasized the importance of proactive conservation and habitat management. While it shared common concerns with studies on the Muleta, Angono, and Lower Agusan Rivers, such as habitat degradation, the need for stronger environmental policies, and the ecological role of riparian vegetation (Esperanza 2015; Sarmiento et al. 2017; Amper et al. 2019), this study provided a more comprehensive ecological baseline, particularly in the uses of woody plant species.

Local communities used the plant species documented in the Ulot riparian zone for various purposes. These included economic use such as food (21 species), medicine (61 species), fuelwood (21 species), timber and construction materials (64 species), landscaping (8 species) as well as industrial dyes or tannins (8 species), and rope-making (4 species) and of cultural significance such as ornamentals (15 species), and species used for mastication (2 species) as part of the traditional chewing culture on Samar Island, known as *nganga* (Figure 4 and Table 2). Several plant families stood out due to the number of species they included and their range of uses. Fabaceae, Moraceae, Dipterocarpaceae, and Euphorbiaceae were the most frequently mentioned, indicating their richness and versatility. Many species served multiple purposes, such as food, medicine, and timber, reflecting their ecological importance and the broad knowledge local communities had about their uses.

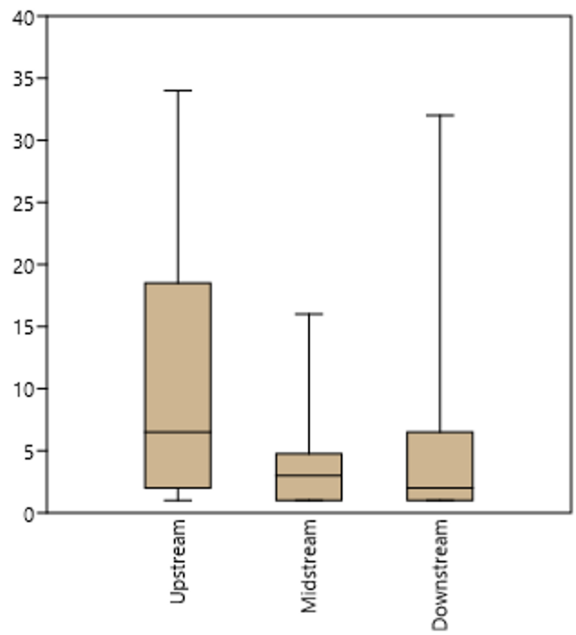

Figure 2. Distribution of individual species represented per family in each river section

Table 1. List of plants in Ulot riparian ecosystem within Samar Island Natural Park, Philippines

Family name-Scientific name	Habit	Location			Exsiccata
		Up stream	Mid stream	Down stream	
Achariaceae					
Hydnocarpus heterophyllus Blume	T		v		
Actinidiaceae					
Saurauia clementis Merr.	S	v			
Anacardiaceae					
Buchanania arborescens (Blume) Blume	T	v	v		
Buchanania heterophylla K.Schum.	T	v			PBDH CKP3-P2N23
Semecarpus cuneiformis Blanco	T	v			PBDH CKP3-P3N44
Annonaceae					
Dasymaschalon clusiflorum (Merr.) Merr.	T			v	
Drepananthus crassipetalus (R.J.Wang & R.M.K.Saunders) Survesw. & R.M.K.Saunders	T		v		
Apocynaceae					
Wrightia laevis Hook.f.	T	v			
Araliaceae					
Heptapleurum insularum Seem.	T		v		
Arecaceae					
Areca catechu L.	P	v		v	PBDH 7879
Areca caliso Becc.	P		v		
Areca costulata Becc.	P			v	PBDH 7828
Caryota rumphiana Mart.	P	v	v		PBDH CKP3-P4N11
Cocos nucifera L.	P	v	v	v	
Heterospathe intermedia (Becc.) Fernando	P		v		
Orania decipiens Becc.	P		v		
Oncosperma tigillarium (Jack) Ridl.	P		v		
Pinanga copelandii Becc.	P	v	v	v	PBDH CKP3-P2N16
Pinanga samarana Becc.	P		v		
Asparagaceae					
Dracaena angustifolia (Medik.) Roxb.	S	v	v	v	PBDH CKP3-P3N5
Bignoniaceae					
Radermachera quadripinnata (Blanco) Seem	T		v		
Burseraceae					
Canarium euryphyllum Perkins	T		v		
Canarium hirsutum Willd.	T		v	v	PBDH 7758
Cannabaceae					
Celtis philippensis Blanco	T	v	v		
Gironniera celtidifolia Gaudich.	T	v	v		
Clusiaceae					
Garcinia macgregorii Merr.	T	v			PBDH CKP3-P2N8
Garcinia rubra Merr.	T	v			PBDH CKP3-P3N33
Combretaceae					
Terminalia nitens C.Presl	T	v			
Dilleniaceae					
Dillenia megalantha Merr.	T		v		
Dipterocarpaceae					
Anisoptera thurifera (Blanco) Blume	T		v		
Dipterocarpus grandifloras (Blanco) Blanco	T		v		
Hopea acuminata Merr.	T	v			
Shorea contorta S.Vidal	T		v		PBDH 7741-42
Shorea guiso (Blanco) Blume	T	v			
Shorea negrosensis Foxw.	T	v	v		PBDH 7746-47
Shorea polysperma (Blanco) Merr.	T	v		v	
Shorea sp.	T		v		PBDH 7749
Elaeocarpaceae					
Elaeocarpus cumingii Turcz.	T	v			
Euphorbiaceae					
Acalypha amentacea Roxb.	S/T	v	v	v	PBDH 7851-52
Acalypha cardiophylla Merr.	S/T		v		
Acalypha sp.	S/T		v		
Hancea wenzeliana (Slik) S.E.C.Sierra, Kulju & Welzen	T	v	v		PBDH 7750-51
Macaranga amplifolia Merr.	T	v			
Macaranga bicolor Müll.Arg.	T	v		v	PBDH 7856;7877-78

Macaranga hispida (Blume) Müll.Arg.	T	v			
Mallotus floribundus (Blume) Müll.Arg.	T			v	PBDH 7811
Mallotus mollissimus (Geiseler) Airy Shaw	T	v			PBDH CKP3-P5N22
Fabaceae					
Adenanthera intermedia Merr.	T		v		
Archidendron scutiferum (Blanco) I.C.Nielsen	T	v	v		
Erythrina subumbrans (Hassk.) Merr.	T		v		
Millettia pinnata (L.) Panigrahi	T			v	PBDH 7846-47
Pterocarpus indicus Willd.	T	v		v	PBDH 7848-50; 7885
Hypericaceae					
Cratoxylum sumatranum (Jack) Blume	T	v			
Lamiaceae					
Clerodendrum lanuginosum Blume	S/T	v			PBDH CKP3-P5N54
Premna odorata Blanco	S/T			v	
Premna tomentosa Willd.	S/T	v			PBDH CKP3-P2N30
Teijsmanniodendron ahernianum (Merr.) Bakh.	T	v			
Teijsmanniodendron pteropodum (Miq.) Bakh.	T	v	v		PBDH CKP3-P3N8
Lauraceae					
Litsea lancifolia (Roxb. ex Nees) Fern.-Vill.	S/T		v		
Litsea philippinensis Merr.	S/T		v		
Lecythidaceae					
Petersianthus quadrialatus (Merr.) Merr.	T			v	PBDH 7809
Lythraceae					
Lagerstroemia speciosa (L.) Pers.	T			v	PBDH 7822-23; 7872-73
Malvaceae					
Commersonia bartramia (L.) Merr.	S/T	v			PBDH CKP3-P5N8
Diplodiscus paniculatus Turcz.	T			v	PBDH 7868; 7874
Grewia multiflora Juss.	S/T	v			
Kleinhovia hospital L.	T	v	v	v	PBDH 7817-19; 7777-78
Melochia umbellata (Houtt.) Stapf	T	v			
Microcos triflora (Blanco) R.C.K.Chung	T	v			PBDH CKP3-P2N48
Sterculia comosa Wall.	T	v			PBDH CKP3-P3N35
Sterculia oblongata R.Br.	T		v		
Sterculia rubiginosa var. divaricata (Merr.) Tantra	T		v		
Theobroma cacao L.	T			v	
Marantaceae					
Donax canniformis (G.Forst.) K.Schum.	S/T	v			PBDH CKP3-P4N32
Melastomataceae					
Astronia megalantha Merr.	T	v	v		PBDH CKP3-P3N31
Melastoma malabathricum L.	S/T	v			PBDH CKP3-P5N2
Meliaceae					
Aglaia elliptica Blume	T	v			PBDH CKP3-P4N13
Aglaia rimosa (Blanco) Merr.	S/T	v	v	v	PBDH 7753-54; CKP3-P3N53
Didymocheton gaudichaudianus A.Juss.	T			v	PBDH 7869
Dysoxylum cyrtobotryum Miq.	T	v			PBDH CKP3-P5N25
Epicharis cumingiana (C.DC.) Harms	T	v			PBDH CKP3-P4N30
Moraceae					
Artocarpus rubrovenius Warb.	T	v	v	v	PBDH 7752; 7815
Artocarpus treculianus Elmer	T	v			PBDH CKP3-P4N35
Ficus cassidyana Elmer	T	v			
Ficus fistulosa Reinw. ex Blume	T		v		
Ficus gul K.Schum. & Lauterb.	T	v	v		PBDH 7686
Ficus heteropoda Miq.	T	v	v	v	PBDH CKP3-P5N13; CKP3-P4N7
Ficus magnoliifolia Blume	T	v			PBDH
Ficus minahassae (de Vriese & Teijsm.) Miq.	T			v	
Ficus nota (Blanco) Merr.	T	v	v	v	PBDH 7779
Ficus pseudopalma Blanco.	F			v	PBDH 7816
Ficus ruficaulis Merr.	T		v		
Ficus septica Burm.f.	T	v		v	
Ficus subulata Blume	S/T			v	PBDH 7810
Ficus ulmifolia Lam.	T	v			
Ficus variegata Blume	T		v	v	
Myristicaceae					
Endocomia macrocoma (Miq.) W.J.de Wilde	T	v			PBDH CKP3-P3N2
Horsfieldia costulata (Miq.) Warb.	T			v	
Knema glomerata (Blanco) Merr.	T	v			PBDH CKP3-P3N14; -P4N25

Myristica cumingii Warb.	T	v			
Myristica fatua Houtt.	T	v	v		PBDH 7759-60; 7687
Myristica nivea Merr.	T	v			PBDH CKP3-P5N12
Myristica philippensis Lam.	T			v	PBDH 7812
Myrtaceae					
Psidium guajava L.	T	v			
Syzygium arcuatinervium (Merr.) Craven & Biffin	T			v	PBDH 7806-08
Syzygium curranii (C.B.Rob.) Merr.	T			v	PBDH 7887-88
Syzygium incrassatum (Elmer) Merr.	T		v		
Syzygium toppingii (Elmer) Merr.	T		v		
Syzygium tripinnatum (Blanco) Merr.	T	v	v		PBDH CKP3-P3N29
Pandanaceae					
Sararanga philippinensis Merr.	PT	v			PBDH CKP3-P2N12; -P3N45
Pentaphylacaceae					
Adinandra leytensis Merr.	T		v		
Phyllanthaceae					
Actephila excelsa (Dalzell) Müll.Arg.	S/T	v	v		PBDH CKP3-P4N3
Antidesma curranii Merr.	T		v		PBDH 7774-76
Antidesma tomentosum Blume	S/T			v	PBDH 7805
Aporosa octandra (Buch.-Ham. ex D.Don) A.R.Vickery	T		v		
Aporosa symplocifolia Merr.	S/T	v	v		PBDH 7738-39; 7688-89
Baccaurea tetrandra (Baill.) Müll.Arg.	T	v			PBDH CKP3-P3N16; -P4N2; -P5N60
Breynia cernua (Poir.) Müll.Arg.	S/T	v			
Cleistanthus oblongifolius (Roxb.) Müll.Arg.	S/T	v			
Glochidion album (Blanco) Boerl.	T	v			PBDH CKP3-P5N23
Glochidion philippicum (Cav.) C.B.Rob.	T		v		PBDH 7740
Piperaceae					
Piper macropiper Pennant	V	v			PBDH CKP3-P5N7
Poaceae					
Bambusa vulgaris Schrad. ex J.C.Wendl.	G			v	PBDH 7866-67
Primulaceae					
Discocalyx angustifolia Mez	S/T	v			
Maesa haenkeana Mez	T			v	PBDH 7875-76
Putranjivaceae					
Drypetes grandifolia (C.B.Rob.) Pax & K.Hoffm.	T	v			
Drypetes longifolia (Blume) Pax & K.Hoffm.	T		v		
Drypetes microphylla (Merr.) Pax & K.Hoffm.	T	v	v		PBDH 7755-57
Rubiaceae					
Antherostele samarensis Obico & Alejandro	S		v	v	PBDH 7813-14
Greeniopsis megalantha Merr.	T		v	v	
Greeniopsis multiflora (Elmer) Merr.	T	v			PBDH CKP3-P2N5
Kanapia monstrosa (A.Rich.) Arriola & Alejandro	S		v		
Morinda citrifolia L.	T			v	PBDH 7825-27; 7845
Mussaenda philippica A.Rich.	T	v		v	PBDH 7841-42; 7843
Mussaenda vidalii Elmer	T		v		
Nauclea orientalis (L.) L.	T		v		
Nauclea subdita (Korth.) Steud.	T		v	v	PBDH 7820-21
Neonauclea formicaria (Elmer) Merr.	T	v		v	PBDH 7853
Neonauclea lanceolata (Blume) Merr.	T	v			PBDH CKP3-P3N66
Wendlandia luzoniensis DC.	S/T	v			PBDH CKP3-P5N4
Rutaceae					
Melicope latifolia (DC.) T.G.Hartley	T	v			PBDH CKP3-P3N1
Melicope triphylla (Lam.) Merr.	T	v			PBDH CKP3-P3N3
Salicaceae					
Scolopia luzonensis (C.Presl) Warb.	T		v		
Sapindaceae					
Allophylus cobbe (L.) Forsyth f.	T			v	
Lepisanthes fruticosa (Roxb.) Leenh.	T		v		
Lepisanthes rubiginosa (Roxb.) Leenh.	T			v	
Sapotaceae					
Pleioluma firma (Miq.) Swenson	T	v	v		PBDH CKP3-P3N7
Sterculiaceae					
Sterculia macrophylla Vent.	T		v		
Thymelaeaceae					
Aquilaria cumingiana (Decne.) Ridl.	T	v			PBDH CKP3-P4N29

Urticaceae					
Leucosyke capitellata (Poir.) Wedd.	T	v			
Oreocnide rubescens (Blume) Miq.	S		v	v	
Oreocnide trinervis (Wedd.) Miq.	S			v	
Vitaceae					
Leea aculeata Blume ex Spreng.	T		v	v	PBDH 7772-73; 7829-30
Leea quadrifida Merr.	T			v	PBDH 7844

Note: Habit (T: Tree, S: Shrub, G: Grass, P: Palm, PT: Pandanloid Tree, V: Vine); Exsiccata (PBDH: Plant Biology Division Herbarium)

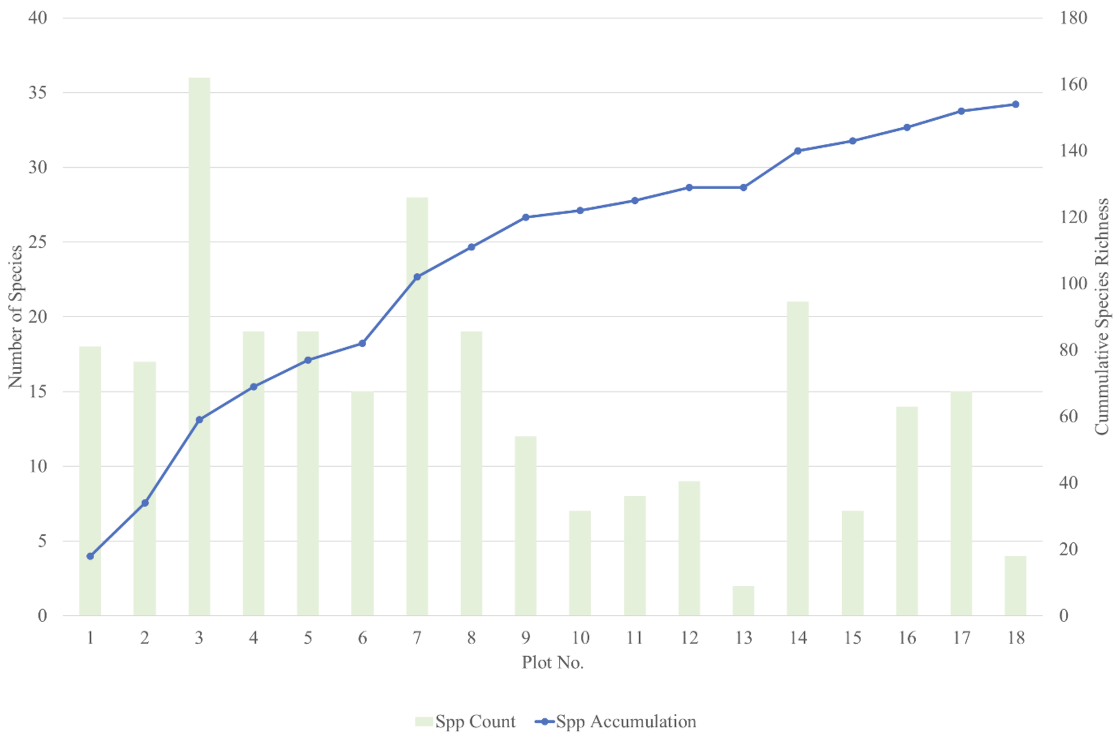

Figure 3. Woody plants species accumulation curve in Ulot riparian zone, Samar Island Natural Park, Philippines

The data showed the dominant uses of species from the top five plant families. Moraceae had the highest number of species (15) and was mainly used for medicine and food. Followed by Rubiaceae with 12 species, commonly used as ornaments. Malvaceae with 10 species, primarily used for food. Euphorbiaceae included 9 species, mostly used for medicine. Arecaceae, with 10 species, had construction as its main uses. Meliaceae had 5 species, mainly used also for construction. This indicated that medicine, food, and construction were the dominant uses among the top families.

One notable species was *Aquilaria cumingiana*, valued for producing high-quality agarwood, a fragrant resin widely used in perfumery and traditional medicine (López-Sampson and Page 2018; Adhikari et al. 2021). Dipterocarps were known as a source of timber (Reyes 1921; EDC 2020q), six of the eight documented dipterocarps were classified as threatened species, with being endemic. *Syzygium* species were also recognized for their economic and industrial value as sources of tannins and dye (EDC 2021h, 2024p), two of which were identified as both vulnerable and endemic. These economically important species were prone to overharvesting and habitat loss, which warrants immediate conservation and sustainable cultivation efforts.

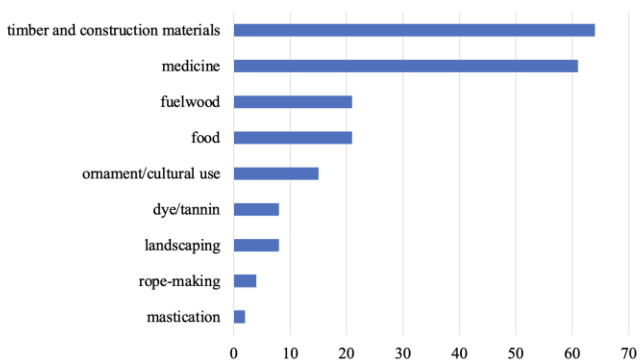

Figure 4. Bar graph showing distribution of species uses

Table 2. Uses, conservation status, and seed storage behavior of species in Ulot riparian ecosystem, Samar Island Natural Park, Philippines

Family-Scientific name	Uses	Reference	Conservation status		Endemicity	Field-notes	Seed storage behavior
			IUCN	DAO 2017-11			
Achariaceae							
Hydnocarpus heterophyllus Blume	Medicine, wood	EDC (2024j)	LC	-		R	
Actinidiaceae							
Saurauia clementis Merr.	Food, wood	EDC (2022c)	LC	-	Endemic	R	Or
Anacardiaceae							
Buchanania arborescens Blume	Medicine, tannin, construction material	Ganesan (2021)	LC	-		F	-
Buchanania heterophylla K.Schum.	Unknown		DD	-		R	Or
Semecarpus cuneiformis Blanco	Medicine	EDC (2024o), Fern (2014i onwards)	LC	-		R	Or
Annonaceae							
Dasymaschalon clusiflorum (Merr.) Merr.	Medicine	IUCN SSC Global Tree Specialist Group and BGCI (2019b)	LC	-		R	-
Drepananthus crassipetalus (R.J.Wang & R.M.K.Saunders) Survesw. & R.M.K.Saunders	Timber	EDC (2020e)	EN	-	Endemic	R	-
Apocynaceae							
Wrightia laevis Hook.f.	Wood	Middleton (2020)	LC	-		R	Or
Araliaceae							
Heptapleurum insularum Seem.	Medicine	EDC (2022b)	LC	-	Endemic	R	-
Arecaceae							
Areca caliso Becc.	Beverage	EDC (2020b)	VU	-	Endemic	R	R
Areca catechu L.	Masticatory	EDC (2024b), Stuart Jr. (2018)	LC	-	Endemic	F	R
Areca costulata Becc.	Landscaping	Solanki et al. (2023)	DD	-		F	R
Caryota rumphiana Mart.	Starch	Botanic Gardens Conservation International (BGCI) and IUCN SSC Global Tree Specialist Group (2018g)	LC	-		F	-
Cocos nucifera L.	Construction material	Stuart Jr. (2024a)	DD	-		A	R
Heterospathe intermedia (Becc.) Fernando	Landscape cultivation	EDC (2020j)	VU	-	Endemic	R	-
Oncosperma tigillarium (Jack) Ridl.	Animal feed, ornament	Hargreaves (2023)	LC	V		R	-
Orania decipiens Becc.	Food, fiber	EDC (2020o)	LC	V	Endemic	R	-
Pinanga copelandii Becc.	Unknown	Pelser et al. (2011 onwards)	NT	-	Endemic	A	Or
Pinanga samarana Becc.	Medicine, ornament	Selina Wamucii (2025a)	EN	CR	Endemic	R	Or
Asparagaceae							
Dracaena angustifolia (Medik.) Ro-b.	Food	Fern (2014b onwards)	-	-		A	Or
Bignoniaceae							
Radermachera quadripinnata (Blanco) Seem.	Ornament, landscaping	de Kok (2024e), Selina Wamucii (2025g)	LC	-		R	-

Burseraceae							
Canarium euryphyllum Perkins	Wood	EDC (2020c)	LC	-	Endemic	R	R
Canarium hirsutum Willd.	Medicine	Botanic Gardens Conservation International (BGCI) and IUCN SSC Global Tree Specialist Group (2018e)	LC	-		F	-
Cannabaceae							
Celtis philippensis Blanco	Timber, construction material	Barstow (2018a)	LC	-		F	-
Gironniera celtidifolia Gaudich.	Ornamental, landscaping	Botanic Gardens Conservation International (BGCI) and IUCN SSC Global Tree Specialist Group (2019c)	LC	-		R	-
Clusiaceae							
Garcinia macgregorii Merr.	Medicine	EDC (2020g)	VU	-	Endemic	F	R
Garcinia rubra Merr.	Medicine, souring agent	EDC (2020h)	NT	-	Endemic	R	R
Combretaceae							
Terminalia nitens C. Presl	Tannin, dye, construction material, fuelwood, charcoal	EDC (2024q)	LC	-		R	Or
Dilleniaceae							
Dillenia megalantha Merr.	Wood	EDC (2020d)	VU	-		R	-
Dipterocarpaceae							
Anisoptera thurifera (Blanco) Blume	Timber	Barstow and Jimbo (2017)	VU	-		R	R
Dipterocarpus grandiflorus	Timber, construction material	Ly et al. (2017)	EN	V		R	Or
Hopea acuminata Merr.	Tannin, construction material	EDC (2020k)	VU	EN	Endemic	R	R
Shorea contorta S.Vidal	Timber, construction material	EDC (2020q)	LC	V	Endemic	R	-
Shorea guiso (Blanco) Blume	Timber, construction material	Khou et al. (2017)	VU	-		R	-
Shorea negrosensis Foxw.	Timber, construction material	EDC (2020r)	LC	-	Endemic	A	R
Shorea polysperma (Blanco) Merr.	Timber, construction material	EDC (2020s)	LC	V	Endemic	R	-
Shorea sp.	Timber	Reyes (1921)	DD	-		R	-
Elaeocarpaceae							
Elaeocarpus cumingii Turcz.	Wood	IUCN SSC Global Tree Specialist Group and Botanic Gardens Conservation International (BGCI) (2019d), Fern (2014d onwards)	LC	-		R	R
Euphorbiaceae							
Acalypha amentacea Roxb.	Medicine, animal feed	POWO (2025)	DD	-		A	-
Acalypha cardiophylla Merr.	Medicine	IUCN SSC Global Tree Specialist Group and Botanic Gardens Conservation International (BGCI) (2019a), Fern (2014a onwards)	LC	-		R	-
Acalypha sp.	Unknown		NE	-		R	-
Hancea wenzeliana (Slik) S.E.C.Sierra, Kulju & Welzen	Timber, construction material, fuelwood	Buot Jr et al. (2024) EDC (2020i)	CR	-	Endemic	A	-
Macaranga amplifolia Merr.	Medicine, adhesive, timber	EDC (2024m)	NT	-	Endemic	R	-
Macaranga bicolor Müll.Arg.	Medicine, fuelwood,	EDC (2020m)	LC	-	Endemic	A	
Macaranga hispida (Blume) Müll.Arg.	Medicine, ornament	Botanic Gardens Conservation International (BGCI) and IUCN SSC Global Tree Specialist Group (2018j)	LC	-		R	Or
Mallotus floribundus (Blume) Müll.Arg.	Medicine	Botanic Gardens Conservation International (BGCI) and IUCN SSC Global Tree Specialist Group (2018l)	LC	-		R	Or
Mallotus mollissimus (Geiseler) Airy Shaw	Medicine	Botanic Gardens Conservation International (BGCI) and IUCN SSC Global Tree Specialist Group (2018k), Slik (2009b onwards)	LC	-		F	

Fabaceae							
Adenanthera intermedia Merr.	Construction	EDC (2022a)	LC	OTS	Endemic	R	Or
Archidendron scutiferum (Blanco) I.C. Nielsen	Construction material	EDC (2020a)	LC	-	Endemic	R	-
Erythrina subumbrans (Hassk.) Merr.	Food, medicine	de Kok (2024a)	LC	-		F	-
Millettia pinnata (L.) Panigrahi	Medicine	Groom (2012)	LC	-		R	Or
Pterocarpus indicus Willd.	Landscape management, ornament	Barstow (2018b), USDA-ARS (2017)	EN	V		F	Or
Hypericaceae							
Cratoxylum sumatranum (Jack) Blume	Medicine, construction material, firewood	Slik (2009a onwards), Botanic Gardens Conservation International (BGCI) and IUCN SSC Global Tree Specialist Group (2019a)	LC	-		R	-
Lamiaceae							
Clerodendrum lanuginosum Blume	Medicine	Ples (2021)	LC	V		R	Or
Premna odorata Blanco	Medicine	de Kok (2022)	LC	-		R	Or
Premna tomentosa Willd.	Medicine	Fern (2014h onwards)	LC	-		R	Or
Teijsmanniodendron ahernianum (Merr.) Bakh.	Construction materials	Botanic Gardens Conservation International (BGCI), IUCN SSC Global Tree Specialist Group (2018m)	LC	-		R	-
Teijsmanniodendron pteropodum (Miq.) Bakh.	Medicine	de Kok (2019), Fern (2014k onwards)	LC	-		A	-
Lauraceae							
Litsea lancifolia (Roxb. ex Nees) Fern.-Vill.	Medicine	de Kok (2020), Goh et al. 2024	LC	-		R	-
Litsea philippinensis Merr.	Construction material	EDC (2020l)	NT	-	Endemic	R	-
Lecythidaceae							
Petersianthus quadrialatus (Merr.) Merr.	Construction material	EDC (2020p)	NT	-	Endemic	R	-
Lythraceae							
Lagerstroemia speciosa (L.) Martyn	Food, medicine, timder	Jimbo (2023a)	LC	-		F	Or
Malvaceae							
Commersonia bartramia (L.) Merr.	Rope-making	Liu et al. (2019)	LC	-		R	-
Diplodiscus paniculatus Turcz.	Timber, construction material	Fern (2014c onwards)	LC	-	Endemic	F	-
Grewia multiflora Juss.	Food, medicine, rope-making	de Kok (2024b)	LC	-		R	Or
Kleinhovia hospita L.	Food, medicine	Liu et al. (2019)	LC	-		A	-
Melochia umbellata (Houtt.) Stapf	Medicine, landscaping	IUCN SSC Global Tree Specialist Group and Botanic Gardens Conservation International (BGCI) (2021b), Selina Wamucii (2025h)	LC	-		R	-
Microcos triflora (Blanco) R.C.K.Chung	Medicine, ornament	Ganesan 2024, Selina Wamucii (2025i)	LC	-		R	-
Sterculia comosa Wall.	Construction material, fiber, rope-making	Stuart Jr. (2024d)	LC	-		F	Or
Sterculia oblongata R.Br.	Rope	IUCN SSC Global Tree Specialist Group and Botanic Gardens Conservation International (BGCI) (2019m), Fern (2014l onwards)	LC	-		R	Or
Sterculia rubiginosa var. *divaricata*	Wood, fiber	de Kok (2024g)	LC	-		R	Or
Theobroma cacao L.	Food, cosmetics	De Souza et al. (2018)	DD	-		F	R

Marantaceae							
Dona- canniformis (G.Forst.) K.Schum.	Antidote	Silalahi and Wakhidah (2020)	DD	-		R	-
Melastomataceae							
Astronia megalantha Merr.	Construction material	EDC (2024d)	NT	-	Endemic	A	-
Melastoma malabathricum L.	Medicine	Joffry et al. (2012)	DD	-		A	Or
Meliaceae							
Aglaia elliptica Blume	Food, construction material	Oldfield (2023)	LC	-		F	R
Aglaia rimosa (Blanco) Merr.	Food, construction material, tannin/dye	EDC (2024a)	LC	OTS		A	R
Didymocheton gaudichaudianus A.Juss.	Medicine	IUCN SSC Global Tree Specialist Group and Botanic Gardens Conservation International (BGCI) (2019c)	LC	-		F	-
Dysoxylum cyrtobotryum Miq.	Construction material	Oldfield (2020a)	LC	-		A	-
Epicharis cumingiana (C.DC.) Harms	Medicine	EDC (2024s)	LC	-		F	-
Moraceae							
Artocarpus rubrovenius Warb.	Food, medicine, construction material	Buot et al. (2024)	DD	OTS	Endemic	F	R
Artocarpus treculianus Elmer	Construction material	EDC (2024c)	LC	V	Endemic	R	R
Ficus cassidyana Elmer	Cultural use	EDC (2020f)	NT	-		F	Or
Ficus fistulosa Reinw. ex Blume	Medicine	Botanic Gardens Conservation International (BGCI) and IUCN SSC Global Tree Specialist Group (2019b), Stuart jr. (2024b)	LC	-		R	-
Ficus gul K.Schum. & Lauterb.	Firewood	Botanic Gardens Conservation International (BGCI) and IUCN SSC Global Tree Specialist Group (2018h)	LC	-		A	Or
Ficus heteropoda Miq.	Medicine	IUCN SSC Global Tree Specialist Group and Botanic Gardens Conservation International (BGCI) (2019e)	LC	-		A	Or
Ficus magnoliifolia Blume	Construction material	EDC (2024)	LC	-		F	Or
Ficus minahassae (de Vriese & Teijsm.) Miq.	Construction material	IUCN SSC Global Tree Specialist Group and Botanic Gardens Conservation International (BGCI) (2019f)	LC	-		F	-
Ficus nota (Blanco) Merr.	Food, firewood, charcoal,	IUCN SSC Global Tree Specialist Group and Botanic Gardens Conservation International (BGCI) (2019g), Stuart Jr (2024c)	LC	-		A	Or
Ficus pseudopalma Blanco.	Medicine	Acosta et al. (2023)	NE	-	Endemic	R	-
Ficus ruficaulis Merr.	Construction material	Agduma et al. (2011)	LC	-		R	-
Ficus septica Burm.f.	Medicine	Botanic Gardens Conservation International (BGCI) and IUCN SSC Global Tree Specialist Group (2019b)	LC	-		R	Or
Ficus subulata Blume	Medicine	Shao et al. (2019a)	LC	-		R	-
Ficus ulmifolia Lam.	Food, medicine	EDC (2024i)	LC	-	Endemic	F	-
Ficus variegata Blume	Exudate	Shao et al. (2019b)	LC	-		R	-
Myristicaceae							
Endocomia macrocoma (Miq.) W.J.de Wilde	Construction material	IUCN SSC Global Tree Specialist Group and Botanic Gardens Conservation International (BGCI) (2024)	LC	-		F	-
Horsfieldia costulata (Miq.) Warb.	Medicine, ornament	IUCN SSC Global Tree Specialist Group and Botanic Gardens Conservation International (BGCI) (2019i)	LC	-		R	-

Knema glomerata (Blanco) Merr.	Medicine	EDC (2024k)	LC	-		F	-
Myristica cumingii Warb.	Construction material, firewood, spice/flavoring	EDC (2023)	LC	-		R	R
Myristica fatua Houtt.	Medicine, wood, ornament	Fern (2014g onwards)	DD	-		F	R
Myristica nivea Merr.	Unknown		DD	-		R	R
Myristica philippensis Lam.	Timber, construction material	EDC (2020n)	LC	OTS	Endemic	R	-
Myrtaceae							
Psidium guajava L.	Medicine	Canteiro and Lucas (2019), Pelser et al. (2011 onwards)	LC	-		R	Or
Syzygium arcuatinervium (Merr.) Craven & Biffin	Tannin, dye, construction material	EDC (2024p)	LC	-		R	R
Syzygium curranii (C.B.Rob.) Merr.	Tannin, dye, construction material	EDC (2021h)	LC	-	Endemic	R	R
Syzygium incrassatum (Elmer) Merr.	Tannin, dye, construction material, fuelwood, charcoal	EDC (2021i)	VU	-	Endemic	R	-
Syzygium toppingii (Elmer) Merr.	Tannin, dye, construction material, fuelwood, charcoal	EDC (2021j)	VU	-	Endemic	R	-
Syzygium tripinnatum (Blanco) Merr.	Food, beverage	ATI (2019)	DD	-		F	-
Pandanaceae							
Sararanga philippinensis Merr.	Food	EDC (2021g)	NT	V	Endemic	R	-
Pentaphylacaceae							
Adinandra leytensis Merr.	Construction material	EDC (2021a)	EN	-	Endemic	R	-
Phyllanthaceae							
Actephila excelsa (Dalzell) Müll.Arg.	Tea	Barstow (2021a)	LC	-		F	-
Antidesma curranii Merr.	Construction material	EDC (2021b)	LC	-	Endemic	R	Or
Antidesma tomentosum Blume	Medicine	Botanic Gardens Conservation International (BGCI) and IUCN SSC Global Tree Specialist Group (2018a)	LC	-		F	-
Aporosa octandra (Buch.-Ham. ex D.Don) Vickery	Animal feed, construction material	Botanic Gardens Conservation International (BGCI) and IUCN SSC Global Tree Specialist Group (2018b)	LC	-		R	-
Aporosa symplocifolia Merr.	Construction material	EDC (2021c)	LC	-	Endemic	F	R
Baccaurea tetrandra (Baill.) Müll.Arg.	Food, poles	Botanic Gardens Conservation International (BGCI) and IUCN SSC Global Tree Specialist Group (2018c)	LC	-		A	R
Breynia cernua (Poir.) Müll.Arg.	Medicine	Botanic Gardens Conservation International (BGCI) and IUCN SSC Global Tree Specialist Group (2018d)	LC	-		R	-
Cleistanthus oblongifolius (Roxb.) Müll.Arg.	Ornament	Botanic Gardens Conservation International (BGCI) and IUCN SSC Global Tree Specialist Group (2018e) Slik (2009c)	LC	-		R	-
Glochidion album (Blanco) Boerl.	Food for moth species	IUCN SSC Global Tree Specialist Group and Botanic Gardens Conservation International (BGCI) (2019e)	LC	-		R	-
Glochidion philippicum (Cav.) C.B.Rob.	Medicine	Botanic Gardens Conservation International (BGCI) and IUCN SSC Global Tree Specialist Group (2019d)	LC	-		R	-
Piperaceae							
Piper macropiper Pennant	Unknown		DD	-		A	I
Poaceae							
Bambusa vulgaris Schrad. e-J.C.Wendl.	Construction material	Gomes et al. (2021), Bacosa Jr et al. (2023)	DD	-		R	-

Primulaceae							
Discocalyx angustifolia Mez	Medicine, ornament	EDC (2021d)	VU	-	Endemic	F	-
Maesa haenkeana Mez	Medicine, ornament	Selina Wamucii (2025c)	NT	-	Endemic	R	-
Putranjivaceae							
Drypetes grandifolia (C.B.Rob.) Pax and K.Hoffm.	Used as posts	EDC (2024e)	LC	-		R	-
Drypetes longifolia (Blume) Pax & K.Hoffm.	Food	Barstow (2021b)	LC	-		R	-
Drypetes microphylla (Merr.) Pax & K.Hoffm.	Medicine	EDC (2024f)	LC	-		F	-
Rubiaceae							
Antherostele samarensis Obico & Alejandro	Unknown		DD	CR	Endemic	R	-
Greeniopsis megalantha Merr.	Medicine	EDC (2021k)	VU	CR	Endemic	R	-
Greeniopsis multiflora (Elmer) Merr.	Medicine	IUCN SSC Global Tree Specialist Group and Botanic Gardens Conservation International (BGCI) (2019h)	LC	-		R	-
Kanapia monstrosa (A.Rich.) Arriola & Alejandro	Medicine	Esguerra et al. (2024)	NE	-		F	-
Morinda citrifolia L.	Medicine, wood, landscape management	de Kok (2024d)	LC	-		R	-
Mussaenda philippica A.Rich.	Ornament	IUCN SSC Global Tree Specialist Group and Botanic Gardens Conservation International (BGCI) (2019j)	LC	-		R	Or
Mussaenda vidalii Elmer	Medicine	EDC (2021)	NT	V	Endemic	R	-
Nauclea orientalis (L.) L.	Food, timber, construction material, landscaping	Barstow (2019)	NE	-		R	-
Nauclea subdita (Korth.) Steud.	Medicine, timber	Oldfield (2020b)	LC	-		R	Or
Neonauclea formicaria (Elmer) Merr.	Construction material, pulp/paper, charcoal	EDC (2021k)	LC	-		F	-
Neonauclea lanceolata (Blume) Merr.	Medicine, ornament	IUCN SSC Global Tree Specialist Group and Botanic Gardens Conservation International (BGCI) (2019k), Selina Wamucii (2025d)	LC	-		F	-
Wendlandia luzoniensis DC.	Masticatory	EDC (2024r)	LC	-		R	-
Rutaceae							
Melicope latifolia (DC.) T.G.Hartley	Medicine, resin	Jimbo (2023b)	LC	-		R	Or
Melicope triphylla (Lam.) Merr.	Medicine	de Kok (2024c)	LC	-		R	-
Salicaceae							
Scolopia luzonensis (C.Presl) Warb.	Fuelwood, construction material	Selina Wamucii (2025f)	NE	-		R	Or
Sapindaceae							
Allophylus cobbe (L.) Forsyth f.	Firewood, medicine, construction material	Svensson (2024)	LC	-		R	-
Lepisanthes fruticosa (Ro-b.) Leenh.	Food, medicine, timber	Botanic Gardens Conservation International (BGCI) and IUCN SSC Global Tree Specialist Group (2018i), Fern (2014e onwards)	LC	-		R	R
Lepisanthes rubiginosa (Ro-b.) Leenh.	Food, medicine, timber	Ye et al. (2019)	LC	-		R	-

Sapotaceae							
Pleioluma firma (Miq.) Swenson	Timber	Olander and Wilkie (2019)	LC	-		R	-
Sterculiaceae							
Sterculia macrophylla Vent.	Wood, fiber	de Kok (2024f), Fern (2014j onwards)	LC	-		R	Or
Thymelaeaceae							
Aquilaria cumingiana (Decne.) Ridl.	Agarwood	Harvey-Brown (2018)	VU	V		F	R
Urticaceae							
Leucosyke capitellata (Poir.) Wedd.	Medicine	IUCN SSC Global Tree Specialist Group and Botanic Gardens Conservation International (BGCI) (2021a) Fern (2014f onwards)	LC	-		F	-
Oreocnide rubescens (Blume) Miq.	Ornament	Shao et al. (2019c), Selina Wamucii (2025i)	LC	-		R	-
Oreocnide trinervis (Wedd.) Miq.	Medicine, ornament	EDC (2024n)	LC	-		R	-
Vitaceae							
Leea aculeata Blume e- Spreng.	Medicine	EDC (2024l)	LC	-		A	-
Leea quadrifida Merr.	Unknown		NE	-	Endemic	R	-

Note: Conservation status based on the IUCN Red list of Threatened Species (NE: Not Evalauated, DD: Data Deficient, LC: Least Concern, NT: Near Threatened, VU: Vulnerable, EN: Endangered, CR: Critically Endangered) and the DENR Administrative Order 2017-11 (2017) (DD: Data Deficient, OTS: Other Threatened Species, LC: Least Concern, V: Vulnerable, EN: Endangered, CR: Critically Endangered). Fieldnotes (A: Abundant, F: Few, R: Rare). Seed Storage Behavior (R: Recalcitrant, Or: Orthodox, I: Intermediate)

Figure 5 showed the distribution and uses of endemic and non-endemic species. Non-endemic species made up 108 or 70% of the total number of species, while endemic species accounted for 30% which is 46 species. Among the endemic species, most were used for construction (10%), followed by medicine (6%), wood (3%), food (2%), and tannin (2%). Unfortunately, 39 species were listed in the IUCN Red List of Threatened Species (IUCN 2024) and the National List of Threatened Species (DAO 2017-11 2017). Notably, 30 out of the 39 threatened species were endemic. Four species were critically endangered-three nationally (*Pinanga samarana, Antherostele samarensis*, and *Greeniopsis megalantha*) and one globally (*Hancea wenzeliana*). Endangered species included *Drepananthus crassipetalus, Adinandra leytensis* and *Hopea acuminata*. Eight endemic vulnerable species were globally vulnerable (*Areca caliso, Discocalyx angustifolia, Garcinia macgregorii, G. megalantha, Heterospathe intermedia, H. acuminata, Syzygium incrassatum, S. toppingii*) and six were nationally listed (*Artocarpus treculianus, Mussaenda vidalii, Orania decipiens, Sararanga philippinensis, Shorea contorta* and *S. polysperma).*

Eight endemic species were categorized as Near Threatened: *Astronia megalantha, Garcinia rubra, Litsea philippinensis, Macaranga amplifolia, Maesa haenkeana, M. vidalii, Petersianthus quadrialatus* and *Pinanga copelandii*, while there were three endemic species nationally tagged as other threatened species: *Adenanthera intermedia, Artocarpus rubrovenius* and *Myristica philippensis*. Evident anthropogenic disturbances through various land use types were observed in downstream, midstream, and upstream areas. These threatened species could either be raised to a more alarming level or lowered to a better state depending on the conservation efforts especially at the community level. These findings highlighted the ecological, economic, cultural, and global significance of the plant species found in Ulot riparian zone. Urgent need for conservation efforts to protect its diverse and threatened plant species, whether in situ or ex situ, was imperative.

Seed storage behavior

In relation to the call for conservation in the previous section, there was a need to study the seed storage of the important plant species in the Ulot riparian zone. The seed storage behavior data was available for some species, while others were only represented at the genus level. Among the 154 documented species in the Ulot riparian zone, 37 species were characterized as orthodox, 28 species were recalcitrant, and one species was identified as intermediate (Table 2). The seed storage behavior of the remaining species had yet to be examined, suggesting that there were still gaps in documentation and areas for further ethnobotanical research. Six threatened species or about 6% of the documented species were identified as having recalcitrant seeds (Figure 6): *A. caliso*, *G. macgregorii*, *G. rubra*, *Anisoptera thurifera*, *H. acuminata,* and *A. cumingiana*. Recalcitrant seeds could not withstand drying and preserved using conventional seed banking strategies (Umarani et al. 2015; Xu et al. 2020). This implied the need for resource-intensive strategies like cryopreservation, tissue culture, or botanic gardens. Hence, the need for stronger in situ habitat protection and restoration could be emphasized.

Conversely, for orthodox species exhibited desiccation tolerance, their seeds could survive drying and freezing during ex situ conservation (Kallow et al. 2020; Matilla 2021). There were 5% of the threatened species that were identified as orthodox: *P. copelandii, P. samarana, Dipterocarpus grandifloras, Pterocarpus indicus, Ficus cassidyana*, and *Scolopia luzonensis*. This implied that conservation efforts for these species were relatively straightforward and cost-effective (Solberg et al. 2020). These species could be stored in seed banks under controlled conditions for long periods without significant loss of viability, minimizing the need for frequent regeneration (Trusiak 2022).

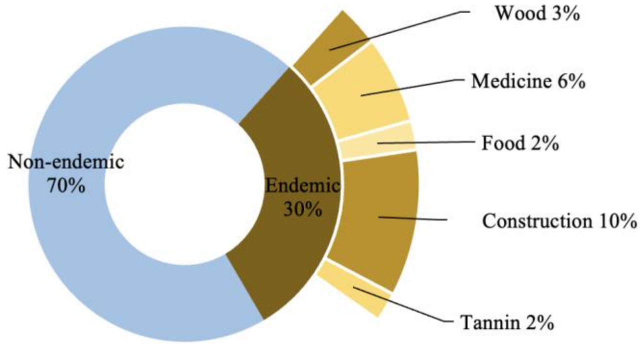

Figure 5. Percentage of uses among endemic species in Ulot riparian zone, Samar Island Natural Park, Philippines

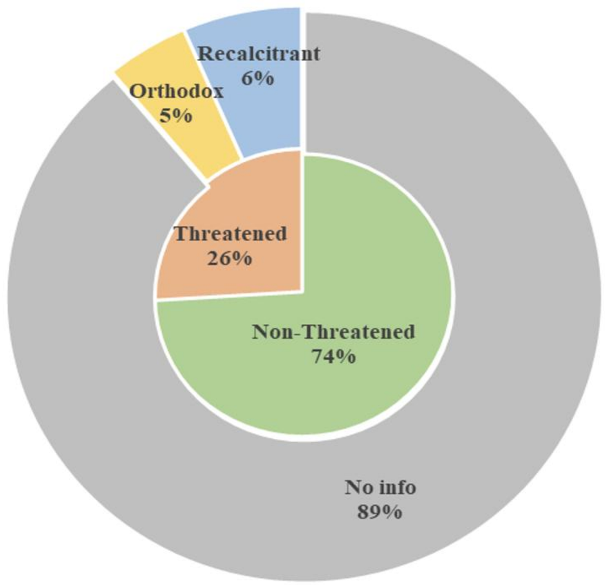

Figure 6. Pie chart showing proportion of recalcitrant vs. orthodox seeds among threatened species

For species with intermediate seed storage behavior, conservation efforts became more challenging compared to orthodox seeds. These seeds exhibited partial desiccation tolerance but could not survive extreme drying or freezing for extended periods (Dussert et al. 2018; Stavrinides et al. 2020). As a result, their long-term preservation required careful moisture control and alternative storage methods, such as cryopreservation or controlled-temperature storage, to maintain viability (Delouche et al. 2021). Species with intermediate seed behavior was *Piper macropiper.* Hence, this required intensive research and the use of specialized laboratory equipment and facilities, which also implied greater cost to ensure the conservation of genetic diversity in this species (Kashimshetty et al. 2017).

Conservation framework

The proposed conservation framework presents a balanced approach to achieving stable riparian ecosystem services by integrating responsible resource consumption and the protection of the identified threatened species (Figure 7). This framework is strengthened by the supervision of the SINP Protected Area Management Bureau, which serves as the primary governing body responsible for overseeing conservation initiatives within SINP. Their leadership ensures coordination, policy enforcement, and alignment with the national conservation objectives. On one side, responsible consumption focuses on sustainable strategies such as implementing environmental policies, engaging local stakeholders, promoting environmental education and awareness, and supporting ecotourism. These efforts are carried out in close partnership with the local communities and people organizations like Basaranan Nga Organisasyon Han San Isidro (BOSIS), Tenani Association for Women and Development (TAWAD) and the Tour Guides and Boat Operators for River Protection and Environmental Development Organization (TORPEDO), ensuring that conservation actions reflect the knowledge, needs, and participation of the people who depend on these ecosystems. Such collaboration not only improves local livelihoods but also foster stewardship of natural resources.

On the other side, conservation actions aim to protect biodiversity through a combination of in-situ and ex situ methods. Seed banking of the nine identified orthodox species that are endemic and threatened is highly recommended. A key site for this initiative is the nursery managed by BOSIS, which provides an ideal location for establishing seed banks and propagating native species. Other conservation actions such as restoration of disturbed habitats, and establishment of riparian key biodiversity area and botanical nursery gardens, ensure the survival and proliferation of threatened species in the locality.

The two pillars are interconnected, emphasizing that sustainable use and conservation must work together to maintain ecological stability. By implementing these strategies collectively, the framework offers the conservation and protection of riparian ecosystems, which are essential for biodiversity, water quality, and overall ecosystem health. This can also be used as a basis in policy-making in developing local environmental ordinances or regulations that promote sustainable resource management, biodiversity conservation, and ecosystem restoration efforts in the riparian zones of Samar Island.

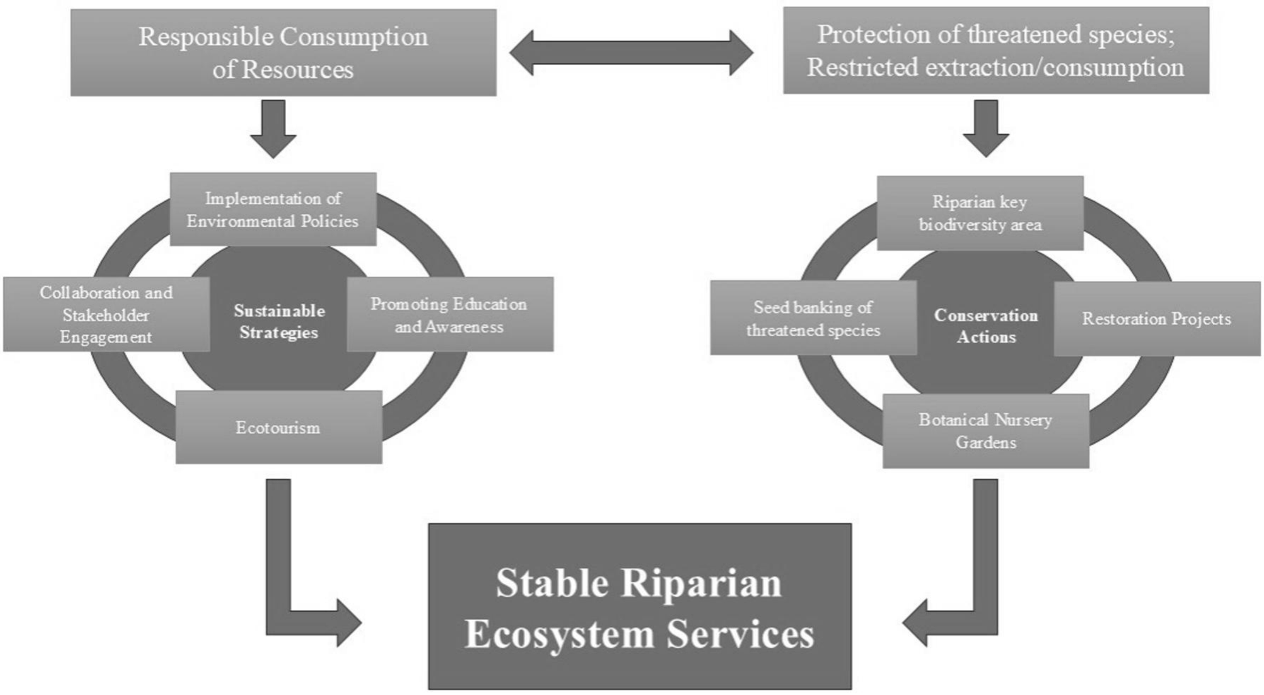

Figure 7. Proposed conservation framework of the identified plant species in Ulot riparian ecosystem, Samar Island Natural Park, Philippines

In conclusion, the riparian ecosystem of the Ulot River in SINP hosts a variety of woody plant species, with a significant proportion of the sampled plants being trees. Given the number of identified flora, their local uses, endemicity, and conservation status, prioritizing the protection of species that are both endemic and threatened is crucial. These species play a vital role in maintaining ecological balance by providing habitat and food for wildlife while also supporting local livelihoods through resource availability and ecotourism opportunities. Their conservation is essential not only for preserving biodiversity but also for sustaining the critical ecological services that the Ulot River provides. Implementing protective measures, such as habitat restoration and conservation initiatives, is imperative. Raising awareness among local communities about the importance of these species further strengthens conservation efforts, ensuring the long-term sustainability of the SINP riparian ecosystem. Accordingly, a conservation framework is proposed in pursuit of a stable Ulot riparian ecosystem service, built upon the integration of sustainable strategies with effective conservation actions.

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