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Cover: Mugger Crocodile basking on the banks of Savitri River at Mahad in Maharashtra, India. © Utkarsha M. Chavan.

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COMMUNICATION

Some threatened woody plant species recorded from forests over limestone of the Philippines

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Abstract: This study was conducted to determine threatened woody plants in forests over limestone in Samar Natural Park (SINP), Guiuan Marine Resource Protected Landscapes and Seascapes (GMRPLS), and other areas in the Philippines, in order to design a strategic framework for sustainable conservation of threatened species. Combined fieldwork using standard vegetation techniques and comparative literature review were done. Results revealed a total of 196 woody plant species belonging to 48 families, with 60 (DAO 2017-11) and 182 (IUCN) threatened woody plant species in the forests over limestone. The top 10 important species noted include three Critically Endangered: *Diospyros longiciliata* Merr., *Cynometra cebuensis* Seidenschwarz, F., and *Shorea astylosa* Foxw; three Endangered: *Cinnamomum cebuense* Kosterm., *Tectona philippinensis* Benth. & Hook.f. and *Vitex parviflora* Juss.; and four Vulnerable species: *Agathis philippinensis* Warb., *Aquilaria cumingiana* (Decne) Ridley, *Dipterocarpus gracilis* Blume, and *Shorea polysperma* (Blanco) Merr. A framework for sustainable conservation has been designed to prevent the loss of these threatened botanical treasures.

Keywords: Karst forest, native plants, Philippine teak, Samar Island, Verde Island Passage.

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Author contributions: Inocencio E. Buot, Jr., the paper's main author, led the study, conceptualized the paper, formulated the objectives, providing direction on the flow of the manuscript discussion and was overseeing the revision and review of the paper until publication. Marne G. Origenes contributed to the discussion of results, conservation framework, conclusion, and drafted the paper after the reviews for comments by everyone. Ren Divien R. Obena assisted in the fieldwork, collection and analysis of data, and contributed to the paper discussion. Elaine Loreen C. Villanueva tabulated the data and provided feedback to help improve the discussion. Marjorie D. delos Angeles assisted in the field work, data collection, and provided comments to improve discussion.

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INTRODUCTION

Forests over limestone (karst forests) have unique geomorphological features that result from the dissolution of soluble bedrock, usually carbonates (Day & Urich 2000). Tropical forests over limestone occur in southern Mexico, central America, the Caribbean, and southeastern Asia including the Philippines, which have roughly 35,000 km^2 of karst forests (Piccini & Rossi 1994). Generally, plants experience more stress in this type of forest due to shallow soil substrates, high temperature, and other limiting factors. Hence, unique plants abound and are expected to possess secondary metabolites with high potential against stressors. Plants in forests over limestone are valuable sources of wood and non-wood products for nearby village communities. They also serve as food, medicine, shade plants and perching materials for local fauna and forest pollinators, sustaining life cycles, and ecosystem dynamics. Anthropogenic pressures can result in overharvesting, deforestation, and biodiversity loss.

Karst forests in the Philippines harbor rich biodiversity, but some are also threatened due to human pressures. These include Mount Lantoy in Cebu Island, one of the 117 terrestrial areas designated as Key Biodiversity Areas (KBA) based on vulnerability and irreplaceability criteria (Lillo et al. 2019, 2020, 2021). The area has two Critically Endangered, two Endangered, four Vulnerable, and 16 restricted-range species (CI/DENR-PAWB/Haribon 2006). In another site Cadiz & Buot (2009, 2010) assessed the native trees and woody plants in Cantipla and Tabunan forests in Cebu City. The Cantipla forest clusters were once a continuous forest cover that was part of the Central Cebu National Park (CCNP) and the Kotkot-Lusaran Watershed. On the other hand, the Tabunan forest covers at least 40 ha and is the only large patch of natural virgin forest left in Metro Cebu Watershed and the home to the endemic but threatened *Cinnamomum cebuense* (Quimio 2006). Another unique forest over limestone is found along Verde Island Passage, Batangas, Luzon Island where the endemic Philippine teak, *Tectona philippinensis* Benth. & Hook.f., is a dominant component (Caringal et al. 2019, 2021).

One of the most extensive forests over limestone in the Philippines is in Samar Island Natural Park (SINP) and Guiuan Marine Resource Protected Landscapes and Seascapes (GMRPLS). A number of studies have shown that these areas are rich in biodiversity (Fernandez et al. 2020; Tolentino et al. 2020; Madera et al. 2021; Obeña et al. 2021; Villanueva et al. 2021a,b; Delos Angeles et al. 2022; Tandang et al. 2022). In a series of biodiversity assessments conducted in various municipalities of Samar Island, it was revealed that the municipality of Paranas has been recorded to have 99 plant species from 63 genera and 44 families (Villanueva et al. 2021a). Furthermore, the municipality of Basey has a total of 67 plant species representing 54 genera and 38 families (Villanueva et al. 2021b), and 30 floral species representing 22 genera and 18 families were recorded in Taft, Eastern Samar (Obeña et al. 2021). Fernandez et al. (2020) recorded 41 floral species belonging to 17 families and 24 genera from Calicoan Island in Guiuan, eastern Samar.

Samar Island, specifically the SINP and the GMRPLS, have been severely degraded despite enforced protective policies such as the National Integrated Protected Areas System (NIPAS) Act of 1992. In the last 70 years, there has been significant logging and forest clearing for agricultural purposes in the area (UNDP-GEF 2014). Other threats (SEARCA 2004), include coal and chromite mining, unregulated limestone quarrying, charcoal production, over-harvesting of non-timber forest products (including rattans), pollution from industries, alien species invasion, and the proliferation of small-scale illegal logging. These activities contribute to forest destruction and pose a significant threat to the biodiversity of the island's forests over limestone ecosystem. If current trends continue, these activities could have serious consequences for both plant populations and the livelihoods of the people who rely on forest resources. Unfortunately, species decline from various locations throughout the country has not yet been documented for inclusion in the Philippine red list or the IUCN. Hence, the need to investigate the threatened woody plants in forests over limestone and their conservation status and catalyze additional actions and potentially save a species from extinction (Zahler & Rosen 2013), particularly in areas where future plant species endangerment is expected to be high (Giam et al. 2010). The study specifically aims to: 1) determine the threatened woody plants species in forests over limestone in Samar Island and in other parts of the Philippines and 2) design a strategic framework for sustainable conservation of forests over limestone threatened species.

Information on threatened woody species in limestone forests in the Philippines is critical because it can have a direct impact on human well-being and will help decision makers and stakeholders in better understanding the significance of this study in achieving the United Nations Sustainable Development Goals,

specifically, SDG 1 (no poverty), SDG 6 (clean water and sanitation), SDG 8 (decent work and economic growth), SDG 11 (sustainable cities and communities), SDG 12 (responsible consumption and production), SDG 13 (climate action), and SDG 17 (partnership to achieve the goal).

MATERIALS AND METHODS

The study sites

The primary study area inventoried. Samar Island is the third-largest island in the Philippines archipelago, covering an area of 13,107 km^2 and extending between 10.75-12.75 °N & 124.25-124.75 °E (PhilGIS 2016). The island is considered a botanical diversity hotspot in both the country and the Malesian region (Madulid 2000).

SINP (Figure 1) contains 333,300 ha of the protected area and 125,400 ha of buffer zone, making it the Philippines' largest terrestrial protected area (UNDP-GEF 2014). The park was designated as a forest reserve in 1996, but it was elevated to the status of a natural park in 2003 by Presidential Proclamation No. 442 in accordance with Republic Act No. 7586 (NIPAS Act of 1992). The SINP is situated in Samar island's low rugged central mountain range, which is shared by all three provinces on the island. SINP is made up of 13 municipalities and one city in the province of Samar, 19 municipalities in the province of Eastern Samar, and five municipalities in northern Samar. The interior natural habitats of Samar Island are dominated by lowland evergreen rainforests and limestone forests (UNDP 2007; Taylor et al. 2015). It also has an interior highland with distinct accordant peaks and a surrounding limestone or karst terrain. The landscape in the southern part is made up of jungle-covered limestone ridges. Its geology is predominantly Miocene and Holocene, with a sedimentary formation composed of basement rocks and overlying clastic rocks or limestone (Patindol 2016). It has high biodiversity and is a center of plant and animal diversity and endemism in the Philippines, home to several threatened species from the Eastern Visayas and Mindanao biogeographic regions (Madulid 2000).

GMRPLS (Figure 1), is a protected area located off the coast of the municipality of Guiuan situated in the Province of Eastern Samar, Philippines. It was designated as a protected area by virtue of Presidential Proclamation No. 469 in 1994 and consists of the following islands: Calicoan, Manicani, Suluaan, Tubabao, Victory, Homonhon, and other smaller islands and their surrounding reefs. It also includes the coastal area of mainland Guiuan, which totals 60,448 ha. The land that is now part of the conservation area was previously designated as a Marine Reserve and Tourist Zone in 1978, and it was placed under the administration and control of the Philippine Tourism Authority. It was re-proclaimed and re-classified as a protected landscape/seascape in 1994 under the National Integrated Protected Areas System Act of 1992.

Based on Modified Corona's Climate Classification, Samar Island is divided into two regions. The northeastern part manifests the Type II climate which has no dry season and has a pronounced rain period, particularly during December and January. The southeastern region has a Type IV climate, with rainfall distributed fairly evenly throughout the year. Throughout the year, the island has a humid climate (Kintanar 1984).

Other forests over limestone cited. Other forests over limestone were cited in available literature and included in the analysis (Figure 2). These are Cantipla forest (Cadiz & Buot 2009) and Mount Tabunan (Cadiz & Buot 2010) of Cebu City, Mount Lantoy of southern Cebu (Lillo et al. 2019, 2020, 2021), and the coastal landscapes and seascapes of the Verde Island Passage, Batangas, southern Luzon (Caringal et al. 2019, 2021).

Like the SINP and the GMRPLS, these other forests over limestone were threatened. Mount Lantoy forests declined significantly during the Spanish colonial period to provide lumber for the construction of Spanish galleons (Asia Magazine 1984). Recently, Bensel (2008) reported that agricultural expansion and fuelwood gathering are still increasing – putting pressure on this Cebu's last remaining forests. Respondents also reported illegal logging, hunting, and widespread conversion of forests to agriculture. Despite these, Mount Lantoy KBA is rated moderately disturbed according to the Beynen & Townsend (2005) scoring system. This means that the recorded disturbances and threats in the area do not have critical effects yet on species diversity for the time being. It could not, however, deny the deterioration of native trees that affects the biodiversity, the ecosystem, and the community surrounding Mount Lantoy KBA.

Similarly, even though Cantipla forest was part of the CCNP and Tabunan forest is in the strict protection zone, their forest resources are still being exploited by the local residents. On its first botanical survey in May 1970, most of the dipterocarp forests in Cantipla had already been destroyed (Colina & Jumalon 1974), and the destruction was accelerated due to the widespread practice of swidden agriculture. Similarly, there is occasional tree cutting and rattan harvesting within the Tabunan forest, and its forest exterior is dominated by

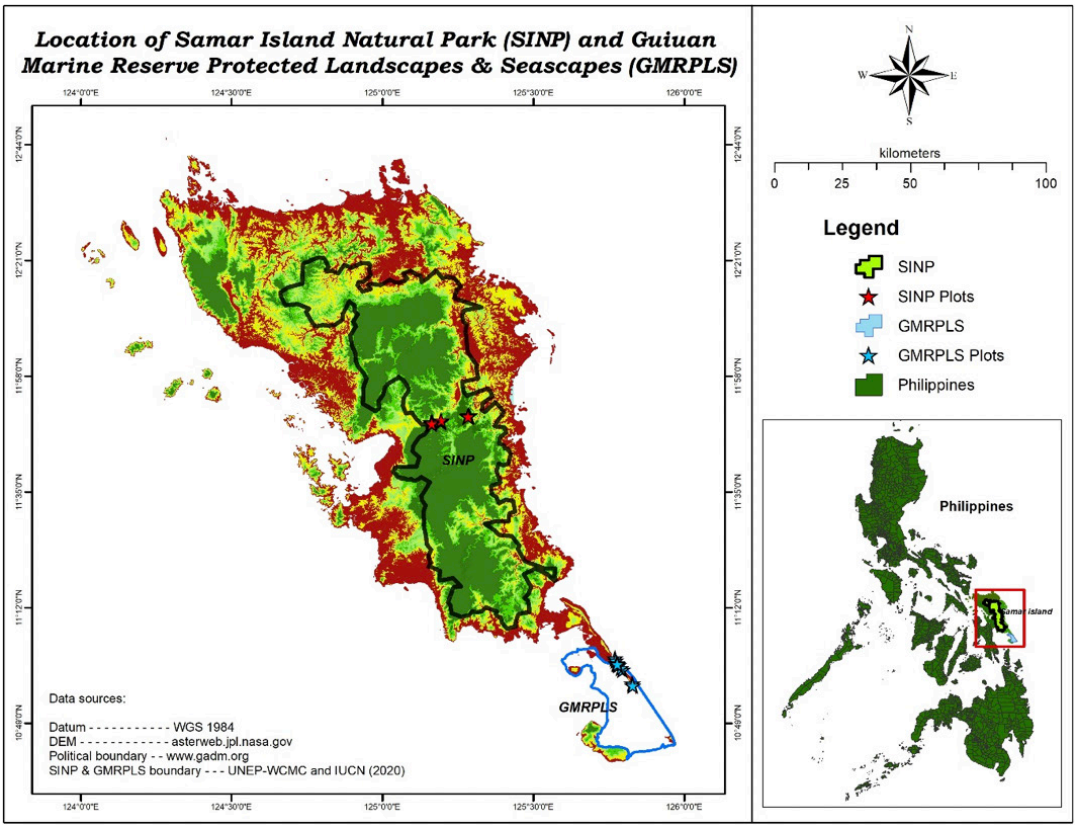

Figure 1. Location of the research area where the authors did the actual fieldwork.

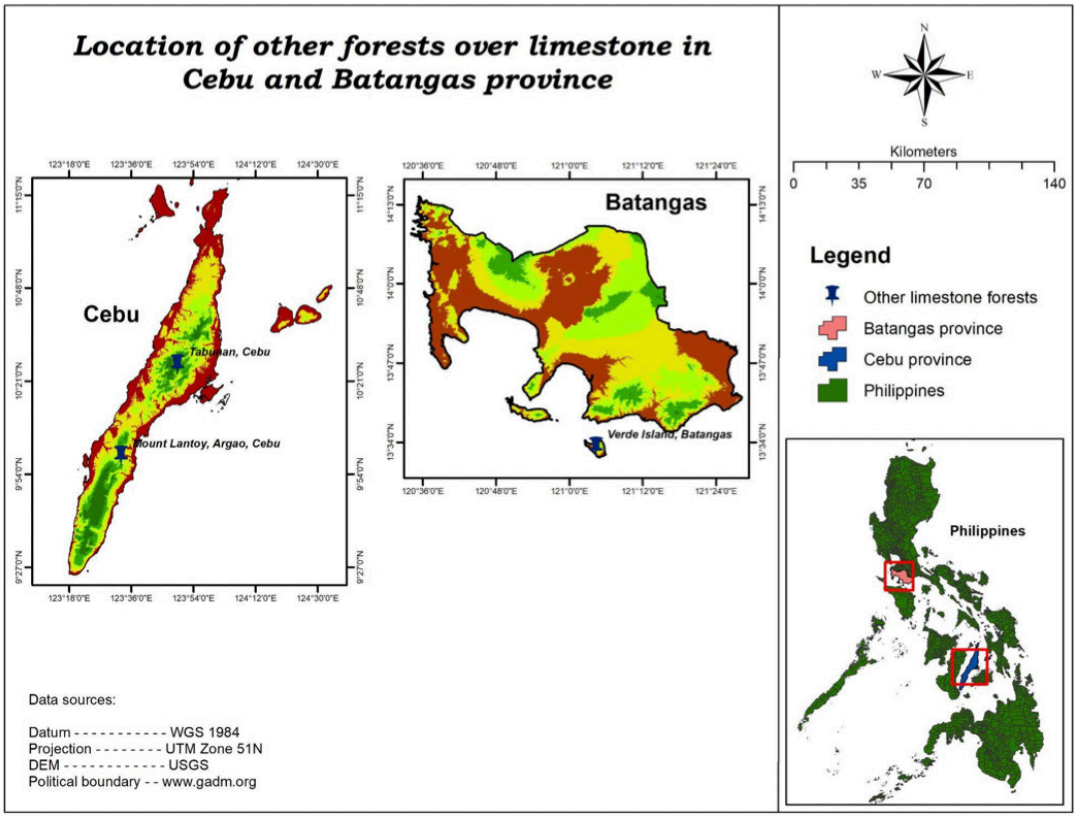

Figure 2. Locations of some forests over limestone included in the study.

agricultural activities of the local residents. In fact, these activities contributed significantly to the reduction of the forested area by approximately 0.3% of its original forest cover (SSC 1988), which is mostly confined to rocky limestone cliffs.

Tectona philippinensis in the forests over limestone along Verde Island Passage, Batangas is an endangered species that has long been regarded as one of the most important floristic elements of this coastal forests over limestone (Madulid & Agoo 1990; DENR-UNEP 1997; Cordon et al. 2004). The tree is also an iconic species, a living witness to the Filipino people's economic and political history, as its wood was once used to repair galleon ships that plied the Manila-Acapulco route during the Spanish colonial era (ERDB 1998). Meanwhile, the number of remaining Philippine teak populations is decreasing due to rapid and continuous destructive human disturbances in the area. Land conversion (from forest to sugar apple plantation and coastal area to resorts), habitat destruction, ecotourism projects, quarry operation, development of road networks and lateral expansion of urban settlements, kaingin (slash and burn farming), accidental fire during summer months, and natural threats such as prolonged droughts caused by the El Nino phenomenon and pests and diseases are threats documented by Caringal (2004) and RDC-CALABARZON (2006).

Inventory of the woody species composition

The study was carried out through a combination of fieldwork using standard vegetation techniques in Samar Island, and extensive literature review of papers in forests over limestone in the Philippines. Two sets of field sampling methods were used to determine the plant composition. The quadrat or plot method (Mueller-Dombois & Ellenberg 1974) was used to assess trees (≤1 m) while the line intercept technique was used for understory species. The plots were purposely selected based on the heterogeneity of the plants and the presence and absence of human-related disturbances in the area. To assess the woody plant species, 27 20 x 20 m plots were established in SINP and GMRPLS last October 2019. Generally, 20 m is the longest distance that can be accurately surveyed in a dense forest (Dallmeier 1992). Two line transects, 5 m in length and subdivided with 1 m intervals, were established inside each sampling plot. Altitude and geographic location of each plot and plant species were determined using a geographic positioning system (GPS) device.

Besides fieldwork using standard vegetation techniques in Samar Island, extensive literature review was conducted, on papers related to forests over limestone in the Philippines. These include papers about the Cantipla forest, Cebu (Cadiz & Buot 2009), Mount Tabunan, Cebu (Cadiz & Buot 2010), Mount Lantoy, Cebu (Lillo et al. 2019, 2020, 2021), Verde Island Passage, Batangas (Caringal et al. 2021) and Basey, Samar (Villanueva et al. 2021b).

Experts were consulted to ascertain tree species identification. Nomenclature follows that of Dictionary of Philippine plant names (Madulid 2001, 2001a), Co's Digital Flora (Pelser et al. 2011 onwards), IPNI (2020), and POWO (2022).

Determining threatened taxa

The conservation status of woody plant species was determined using the list of threatened species identified by the Philippines' DENR Administrative Order No. 11 series of 2017 (DAO 2017) and the International Union for Conservation of Nature (IUCN) (IUCN 2022). DAO No. 2017-11 (DAO 2017) is the national reference for threatened species of the Philippines. This is being used by researchers and planners as basis in decision-making related to forest management and conservation. IUCN (IUCN 2022), on the other hand, is the global reference for threatened species of various countries. So, in this study, we made use of these two relevant documents as bases in determining the threatened status of the woody species in forests over limestone.

Designing a framework for conservation

The study proposes a framework for sustainable conservation of threatened species to put a stop to the current and continuing loss of woody plant species in the country. The framework was developed in response to conservation gaps identified in scientific publications, existing policies, reports, and measures that must be taken seriously towards protection and conservation of floral species in forests over limestone. It highlights the practicality and locally doable in situ and ex situ strategies and the extent and dedicated engagement of the government and the community as well as the stakeholders towards the conservation of the threatened woody taxa.

RESULTS AND DISCUSSION

Threatened woody plant species in forests over limestone

The study found 196 woody plant species belonging to 48 families in the forest over limestone in the

Philippines (Table 1). About half (40%) of the recorded species are endemic to the Philippines (DAO 2017-11; Pelser et al. 2011 onwards). Additionally, Moraceae family is the most represented family, having 16 documented species, followed by Fabaceae (16 species), Euphorbiaceae and Dipterocarpaceae, having 15 species each, and Rubiaceae and Sapindaceae, with 10 species each.

Meanwhile, for SINP and GMRPLS alone, a total of 85 (out of 196) woody plant species, including 37 families, were recorded, including the flora checklist in the municipality of Basey, Samar.

As shown in Table 1, 60 woody plant species in Philippine forests over limestone have conservation status recorded in DAO 2017-11, Philippines as follows: 11 Critically Endangered (CR), nine Endangered (EN), 30 Vulnerable (VU), and 10 other threatened species (OTS). The 37 (out of 60) species are endemic to the Philippines. On the other hand, IUCN classified 182 woody plant species in the Philippine forests over limestone with seven Critically Endangered (CR), 23 Endangered (EN), 26 Vulnerable (VU), 15 Near Threatened (NT), 110 Least Concern (LC), and one Data Deficient (DD) (Table 1). The 75 of the 182 woody species determined by IUCN are Philippine endemics. In addition, it was noticed that among the woody plant species in the Philippines, there are only five Endangered species, and seven Vulnerable species have the same conservation status in DAO 2017-11 and the IUCN.

Figures 3 and 4 show a comparison of the conservation status of threatened species found on Samar Island, Cebu, and Batangas based on DAO 2017-11 and IUCN. In contrast to the DAO 2017-11 assessment, many of the species found in limestone forests were classified in the IUCN conservation status assessment, as shown in Figure 3. Samar Island has 43 species classified by DAO 2017-11, with seven CR, five EN, 22 VU, and nine OTS, and 80 species classified by IUCN, with six CR, 13 EN, 17 VU, nine NT, and 35 LC. Mt. Tabunan has four species classified by DAO 2017-11 (one CR and three VU), and 41 species classified by IUCN (one CR, two EN, one VU, three NT, 33 LC, and one DD). *Mangifera altissima* Blanco is the only DD species found on Mt. Tabunan. This species was, however, classified as vulnerable in DAO 2017-11. Additionally, Mt. Cantipla has three species classified by DAO 2017-11 (two CR and one EN), while 23 species classified by IUCN (seven EN, three VU, two NT, and 11 LC). Mt. Lantoy has 17 species classified by DAO 2017-11 (two CR, three EN, nine VU, and three OTS), and 12 species classified by IUCN (two EN, three VU, one NT and six LC). Verde Island Passage has three species classified by DAO 2017-11, with two EN and one VU, and 50 species classified by IUCN, with two EN, three VU, and 45 LC, respectively (see Table 1; Figure 3, 4). Based on DAO 2017-11 and IUCN assessments, Samar Island has the highest number of CR, EN, VU, OTS, and NT species, while Verde Island Passage in Batangas has the highest number of Least Concern (LC) species (see Figure 2,3). The low number of species classified by DAO 2017-11 could be attributed to the fact that the Philippine red list was out of date, as the listing was made in 2017. This figure may change if the assessment and listing of threatened species in the Philippines are completely

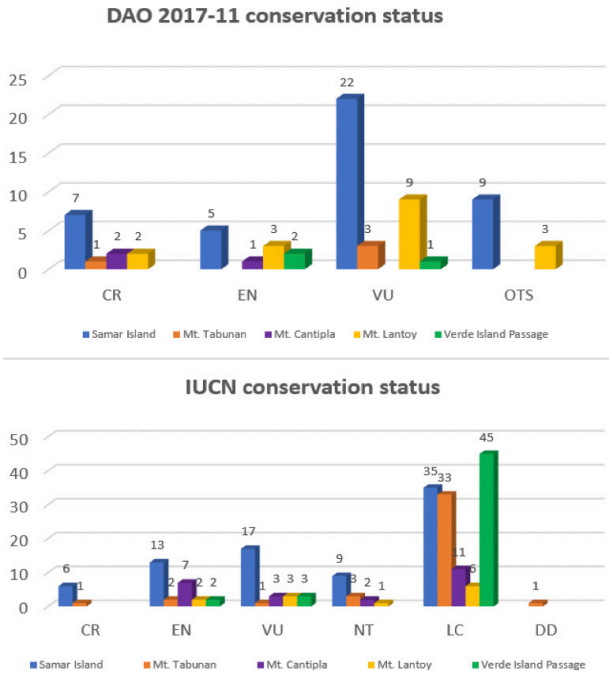

Figure 3. Conservation status of the threatened taxa in Samar Island, Mt. Tabunan, Mt. Cantipla, & Mt. Lantoy, Cebu, and Verde Island Passage, Batangas.

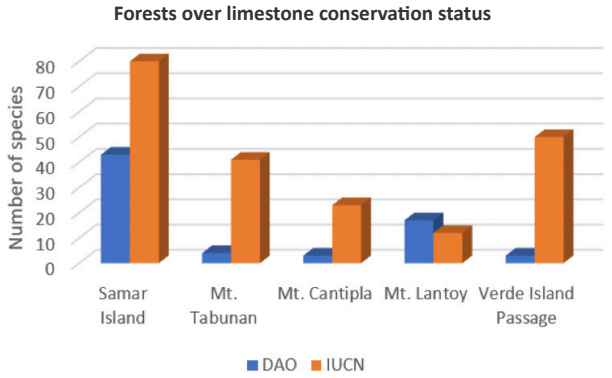

Figure 4. Comparison of assessments by IUCN & DAO of threatened woody species in forests over limestone.

Table 1. List of threatened woody plant species in forests over limestone in the Philippines.

	Family & scientific name	Common name	Location	Endemicity	Conservation status		References
					DAO 2017-11	IUCN	
1	**Achariaceae**						
	Hydnocarpus subfalcatus Merr.	Damol, Ngeret	Basey, Samar	Native	-	LC	Quimio (2016); Villanueva et al. (2021b)
2	**Anacardiaceae**						
	Dracontomelon dao (Blanco) Merr. & Rolfe	Dao	Basey, Samar	Native	VU	LC	Quimio (2016); Villanueva et al. (2021b)
	Mangifera altissima Blanco	Paho	Mount Tabunan, Cebu	Endemic	VU	DD	Cadiz & Buot (2010)
	Mangifera monandra Merr.	Malapaho, Malipajo	Paranas, Samar	Endemic	VU	NT	Villanueva et al. (2021a)
3	**Annonaceae**						
	Annona squamosa L.	Sugar Apple, Atis	Verde Island Passage, Batangas	-	-	LC	Caringal et al. (2021)
	Goniothalamus elmeri Merr.	Lanutan	Mount Tabunan, Cebu	Endemic	-	LC	Cadiz & Buot (2010)
	Goniothalamus lancifolius Merr.	Monat	Paranas, Samar	Endemic	EN	EN	Villanueva et al. (2021a)
	Orophea cumingiana S. Vidal	Amúnat, Karasákat, Lobanti	Paranas, Samar	Endemic	OTS	NT	Villanueva et al. (2021a)
4	**Apocynaceae**						
	Alstonia macrophylla Wall. Ex DC.	Batino, Devil Tree	Mount Tabunan, Cebu	Native	-	LC	Cadiz & Buot (2010)
	Alstonia scholaris (L.) R. Br.	Dita	Mount Tabunan, Cebu; Calicoan, Guiuan	Native	-	LC	Cadiz & Buot (2010); Fernandez et al. (2020)
	Kibatalia merrilliana Woodson	Merrill Pasnit	Paranas, Samar	Endemic	VU	EN	Villanueva et al. (2021a)
	Kibatalia puberula Merr.	Pasnit-mabolo	Paranas, Samar	Endemic	EN	EN	Villanueva et al. (2021a)
	Tabernaemontana pandacaqui Poir.	Banana Bush, Pandakaki	Verde Island Passage, Batangas	Native	-	LC	Caringal et al. (2021)
	Voacanga globosa (Blanco) Merr.	Bayag-usa, Testicle Tree, Alibutbut	Verde Island Passage, Batangas	Endemic	-	LC	Caringal et al. (2021)
	Wrightia pubescens R. Brown subsp. *Laniti* (Vidal) Ngan	Lanete	Verde Island Passage, Batangas	Native	-	LC	Caringal et al. (2021)
5	**Araliaceae**						
	Osmoxylon serratifolium (Elmer) Philipson	-	Mount Tabunan, Cebu	Endemic	-	EN	Cadiz & Buot (2009, 2010)
	Polyscias nodosa (Blume) Seem.	Malapapaya	Paranas, Samar	Native	-	LC	Villanueva et al. (2021a)
6	**Araucariaceae**						
	Agathis philippinensis Warb.	Almaciga	Basey, Samar	Native	VU	-	Quimio (2016); Villanueva et al. (2021b)
7	**Arecaceae**						
	Caryota rumphiana Mart.	Pugahan	Calicoan, Guiuan; Paranas, Samar	Native	-	LC	Fernandez et al. (2020); Villanueva et al. (2021a)
	Heterospathe intermedia (Becc.) Fernando	Banga, Marighoi	Calicoan, Guiuan; Taft, Eastern Samar; Paranas, Samar	Endemic	-	VU	Fernandez et al. (2020); Obeña et al. (2021); Villanueva et al. (2021a)
	Oncosperma tigillarium (Jack) Ridl. Syn. *Filamentosum* Blume.	Anibong	Paranas, Samar	Native	VU	-	Villanueva et al. (2021a)
	Saribus rotundifolius (Lam.) Blume	Anahaw	Calicoan, Guiuan; Taft, Eastern Samar	Native	OTS	-	Fernandez et al. (2020); Obeña et al. (2021)
8	**Bignoniaceae**						
	Radermachera pinnata (Blanco) Seem. Syn. *R. Quadripinnata*	Banaybanay	Basey, Samar	Native	-	LC	Quimio (2016); Villanueva et al. (2021b)
9	**Boraginaceae**						
	Cordia dichotoma Forst.f.	Anonang, Soap Berry	Verde Island Passage, Batangas	Native	-	LC	Caringal et al. (2021)
10	**Burseraceae**						
	Canarium hirsutum Willd.	Milipili, Dulit	Cantipla, Cebu; Paranas, Samar; Basey, Samar	Native	-	LC	Cadiz & Buot (2009); Quimio (2016); Villanueva et al. (2021a, b)

	Family & scientific name	Common name	Location	Endemicity	Conservation status		References
					DAO 2017-11	IUCN	
	Canarium ovatum Engl.	Pili	Basey, Samar	Native	OTS	LC	Quimio (2016); Villanueva et al. (2021b)
	Garuga floribunda Decne *var. Floribunda*	Bogo, Kedondong	Verde Island Passage, Batangas	Native	-	LC	Caringal et al. (2021)
11	**Calophyllaceae**						
	Calophyllum soulattri Burm. F.	Pamintaogon	Mount Tabunan, Cebu; Calicoan, Guiuan; Taft, Eastern Samar; Paranas, Samar	Native	-	LC	Cadiz & Buot (2010); Fernandez et al. (2020); Obeña et al. (2021); Villanueva et al. (2021a)
12	**Cannabaceae**						
	Celtis philippensis Blanco	Malaiino; Celtis, Malaikmo, Magabuyo	Mount Tabunan, Cebu	Native	-	LC	Cadiz & Buot (2010)
	Trema orientalis (L.) Blume	Andrarezina	Verde Island Passage, Batangas	Native	-	LC	Caringal et al. (2021)
13	**Capparidaceae**						
	Crateva religiosa Forst. F.	Balay-lamok	Verde Island Passage, Batangas	Native	-	LC	Caringal et al. (2021)
14	**Casuarinaceae**						
	Gymnostoma rumphianum (Miq.) L. Johnson	Agoho del Monte, Mountain Agoho	Mount Lantoy, Cebu; Paranas, Samar	Native	OTS	-	Lillo et al. (2019), Villanueva et al. (2021a)
15	**Clusiaceae**						
	Garcinia rubra Merr.	Kamandiis	Paranas, Samar	Endemic	-	NT	Villanueva et al. (2021a)
16	**Combretaceae**						
	Terminalia calamansanai (Blanco) Rolfe	Malakalumpit	Cantipla, Cebu	Native	-	LC	Cadiz & Buot (2009)
	Terminalia catappa Linn.	Talisay	Verde Island Passage, Batangas	Native	-	LC	Caringal et al. (2021)
17	**Cycadaceae**						
	Cycas riuminiana Regel	Pitogo, Bayit	Taft, Eastern Samar	Endemic	VU	EN	Obeña et al. (2021)
18	**Dilleniaceae**						
	Dillenia philippinensis Rolfe	Katmon	Basey, Samar	Endemic	-	NT	Quimio (2016); Villanueva et al. (2021b)
19	**Dipterocarpaceae**						
	Dipterocarpus gracilis Blume	Panau	Basey, Samar	Native	VU	VU	Quimio (2016); Villanueva et al. (2021b)
	Hopea foxworthyi Elmer	Dalingdingan	Basey, Samar	Endemic	CR	EN	Quimio (2016); Villanueva et al. (2021b)
	Hopea malibato Foxw.	Yakal-kaliot	Basey, Samar	Endemic	CR	VU	Quimio (2016); Villanueva et al. (2021b)
	Hopea philippinensis Dyer	Gisok-gisok, Gisok	Mount Tabunan, Cebu; Taft, Eastern Samar, Paranas, Samar	Endemic	CR	EN	Cadiz & Buot (2010); Obeña et al. (2021); Villanueva et al. (2021a)
	Hopea quisumbingiana Gutierrez	Quisumbing Gisok	Paranas, Samar	Endemic	CR	EN	Villanueva et al. (2021a)
	Hopea samarensis Gutierrez	Samar Gisok	Paranas, Samar	Endemic	CR	EN	Villanueva et al. (2021a)
	Parashorea malaanonan (Blanco) Merr.	Bagtikan	Mount Tabunan, Cebu	Native	-	LC	Cadiz & Buot (2010)
	Shorea almon Foxw.	Almon	Basey, Samar	Native	VU	NT	Quimio (2016); Villanueva et al. (2021b)
	Shorea astylosa Foxw.	Yakal	Calicoan, Guiuan; Taft, Eastern Samar; Paranas, Samar; Basey, Samar	Endemic	CR	EN	Quimio (2016); Fernandez et al. (2020); Obeña et al. (2021); Villanueva et al. (2021a, b)
	Shorea contorta Vidal	White Lauan, Lawaan na Puti	Mount Tabunan, Cebu; Parana, Samar	Endemic	VU	LC	Cadiz & Buot (2010); Villanueva et al. (2021a)
	Shorea falciferoides Foxw. [= *Shorea gisok* Foxw.]	Yakal-yamban	Paranas, Samar	Native	VU	CR	Villanueva et al. (2021a)
	Shorea malibato Foxw.	Yakal-malibato	Cantipla, Cebu	Endemic	CR	VU	Cadiz & Buot (2009)

	Family & scientific name	Common name	Location	Endemicity	Conservation status		References
					DAO 2017-11	IUCN	
	Shorea negrosensis Foxw.	Red Lauan, Takuban	Calicoan, Guiuan; Taft, Eastern Samar; Paranas, Samar	Endemic	VU	LC	Fernandez et al. (2020); Obeña et al. (2021); Villanueva et al. (2021a)
	Shorea polysperma (Blanco) Merr.	Tanguile	Mount Lantoy, Cebu; Basey, Samar	Endemic	VU	LC	Quimio (2016); Lillo et al. (2019); Villanueva et al. (2021b)
	Shorea squamata (Turcz.) Dyer ex S. Vidal	Mayapis	Basey, Samar	Endemic	-	LC	Quimio (2016); Villanueva et al. (2021b)
20	**Ebenaceae**						
	Diospyros bulusanensis Elmer syn. *D. Philippinensis*	Baganito, Oi-oi	Basey, Samar	Native	VU	NT	Quimio (2016); Villanueva et al. (2021b)
	Diospyros discolor Willd. [= *D.blancoi* A.DC]	Kamagong	Mount Tabunan, Cebu; Taft, Eastern Samar, Paranas, Samar	Native	VU	-	Cadiz & Buot (2010); Obeña et al. (2021); Villanueva et al. (2021a)
	Diospyros ferrea (Willd.) Bakh.	Batulinaw	Verde Island Passage, Batangas	Native	VU	-	Caringal et al. (2021)
	Diospyros longiciliata Merr.	Itom-itom	Mount Lantoy, Cebu	Endemic	CR	EN	Lillo et al. (2019)
	Diospyros pilosanthera Blanco	Bolong-eta	Mount Lantoy, Cebu	Native	VU	-	Lillo et al. (2019)
	Diospyros pyrrhocarpa Miq.	Anang	Mount Lantoy, Cebu	Native	VU	LC	Lillo et al. (2019)
21	**Elaeocarpaceae**						
	Elaeocarpus fulvus Elmer	Lanauting-dilau	Cantipla, Cebu	Endemic	-	EN	Cadiz & Buot (2009)
22	**Euphorbiaceae**						
	Blumeodendron kurzii (Hook.f.) J.J.Sm. Ex Koord. & Valeton [= *Blumeodendron philippinense* Merr. & Rolfe.]	Salngan	Mount Tabunan, Cebu; Basey, Samar	Native	-	LC	Cadiz & Buot (2010); Quimio (2016); Villanueva et al. (2021b)
	Drypetes globosa (Merr.) Pax & K. Hoffm.	Kalugkugan, Bato-bato	Cantipla, Cebu	Endemic	-	VU	Cadiz & Buot (2009)
	Glochidion philippicum (Cav.) C.B. Rob.	Iba-ibaan	Cantipla, Cebu	Native	-	LC	Cadiz & Buot (2009)
	Hancea cordatifolia (Slik) S.E.C.Sierra, Kulju & Welzen [=*Mallotus cordatifolius* Slik]	-	Basey, Samar	Endemic	-	CR	Slik (1988); Slik and van Welzen (2001); Villanueva et al. (2021b)
	Hancea wenzeliana (Slik) S.E.C.Sierra, Kulju & Welzen	Apanang	Calicoan, Guiuan; Paranas, Samar; Taft, Eastern Samar	Endemic	-	CR	Fernandez et al. (2020); Obeña et al. (2021); Villanueva et al. (2021a);
	Macaranga bicolor Müll.Arg.	Pailig, Amilik, Baranti, Bagambang	Mount Tabunan, Cebu; Calicoan, Guiuan	Endemic	-	LC	Cadiz & Buot (2010); Villanueva et al. (2021a)
	Macaranga grandifolia (Blanco) Merr.	Takip-asin	Mount Tabunan, Cebu	Native	-	VU	Cadiz & Buot (2010)
	Macaranga hispida (Blume) Müll. Arg.	Lagapak	Mount Tabunan, Cebu	Native	-	LC	Cadiz & Buot (2010)
	Macaranga tanarius (L.) Müll.Arg.	Minunga, Binunga	Mount Tabunan, Cebu; Calicoan, Guiuan	Native	-	LC	Cadiz & Buot (2010); Fernandez et al. (2020)
	Mallotus cumingii Muell. –Arg	Apanang	Mount Tabunan, Cebu; Basey, Samar	Native	-	LC	Cadiz & Buot (2010); Quimio (2016); Villanueva et al. (2021)
	Mallotus philippensis (Lam.) Muell-Ang	Kamala Tree, Banato	Verde Island Passage, Batangas	Native	-	LC	Caringal et al. (2021)
	Melanolepis multiglandulosa (Reinw. Ex. Blume) Rchb. F. & Zoll.	Alim	Mount Tabunan, Cebu; Verde Island Passage, Batangas	Native	-	LC	Cadiz & Buot (2010); Caringal et al. (2021)
	Neoscortechinia arborea (Elmer) Pax & K.Hoffm. Syn. *N. Nicobarica* (Hook.f.) Pax & Hoffm	Magong	Cantipla, Cebu	Native	-	LC	Cadiz & Buot (2009)
	Neoscortechinia parvifolia (Merr.) Merr. Syn. *N. Philippinensis* (Merr.)	Magon-liitan	Cantipla, Cebu	Native	-	LC	Cadiz & Buot (2009)
	Tritaxis ixoroides (C.B.Rob.) R.Y.Yu & Welzen	Agindulong	Paranas, Samar	Endemic	-	VU	Villanueva et al. (2021a)

	Family & scientific name	Common name	Location	Endemicity	Conservation status		References
					DAO 2017-11	IUCN	
23	**Fabaceae**						
	Acacia farnesiana (L.) Willd. Syn. *Vachellia farnesiana*	Aroma	Verde Island Passage, Batangas	-	-	LC	Caringal et al. (2021)
	Acacia mangium Willd.	Mangium	Cantipla, Cebu	-	-	LC	Cadiz & Buot (2009)
	Adenanthera intermedia Merr.	Tanglin	Mount Lantoy, Cebu	Endemic	OTS	VU	Lillo et al. (2019)
	Afzelia rhomboidea (Blanco) Vidal	Tindalo	Mount Lantoy, Cebu	Native	EN	-	Lillo et al. (2019)
	Albizia philippinensis Nielsen	Unik	Verde Island Passage, Batangas	Endemic	-	VU	Caringal et al. (2021)
	Albizia procera (Roxb.) Benth.	White Siris	Verde Island Passage, Batangas	Native	-	LC	Caringal et al. (2021)
	Albizia saponaria (Lour.) Miq.	Salingkugi	Basey, Samar	Native	-	LC	Quimio (2016); Villanueva et al. (2021b)
	Archidendron clypearia (Jack) I. C. Nielsen	Alobahay, Inep	Mount Tabunan, Cebu	Native	-	LC	Cadiz & Buot (2010)
	Bauhinia malabarica Roxb.	Alibangbang	Verde Island Passage, Batangas	Native	-	LC	Caringal et al. (2021)
	Cassia spectabilis L.	Antsoan-dilau	Cantipla, Cebu	-	-	LC	Cadiz & Buot (2009)
	Cynometra cebuensis F.Seid.	Nipot-nipot	Mount Lantoy, Cebu	Endemic	CR	-	Lillo et al. (2019)
	Cynometra copelandii (Elmer) Elmer	Matolog	Mount Taburan, Cebu	Endemic	-	CR	Cadiz and Buot (2010)
	Gliricidia sepium (Jacq.) Kunth ex Walp.	Madre de Cacao	Verde Island Passage, Batangas	-	-	LC	Caringal et al. (2021)
	Intsia bijuga (Colebr.) Kuntze	Ipil	Mount Lantoy, Cebu	Native	VU	NT	Lillo et al. (2019)
	Tamarindus indica Linn.	Tamarind, Sampalok	Verde Island Passage, Batangas	-	-	LC	Caringal et al. (2021)
	Wallaceodendron celebicum Koord.	Banuyo, Salonggigi	Mount Lantoy, Cebu; Calicoan, Guiuan, Taft, Eastern Samar; Paranas, Samar	Native	VU	-	Lillo et al. (2019); Fernandez et al. (2020); Obeña et al. (2021); Villanueva et al. (2021a)
24	**Fagaceae**						
	Lithocarpus celebicus (Miq.) Rehder [= *Lithocarpus llanosii* (A.DC.) Rehder]	Ulaian	Basey, Samar	Native	-	LC	Quimio (2016); Villanueva et al. (2021b)
25	**Gesneriaceae**						
	Teijsmanniodendron pteropodum (Miq.) Bakh.	Tikoko	Basey, Samar	Native	-	LC	Quimio (2016); Villanueva et al. (2021b)
26	**Gnetaceae**						
	Gnetum gnemon L.	Bago	Mount Tabunan, Cebu; Calicoan, Guiuan; Taft, Eastern Samar; Basey, Samar	Native	-	LC	Cadiz & Buot (2010); Quimio (2016); Fernandez et al. (2020); Obeña et al. (2021); Villanueva et al. (2021b)
27	**Hypericaceae**						
	Cratoxylum sumatranum (Jack) Blume subsp. *Sumatranum*	Kansilay, Guyong-guyong	Verde Island Passage, Batangas	Native	-	LC	Caringal et al. (2021)
28	**Icacinaceae**						
	Stemonurus gitingensis (Elmer) Sleumer	Tugbak	Cantipla, Cebu	Endemic	-	EN	Cadiz & Buot (2009)
29	**Lamiaceae**						
	Callicarpa erioclona Schauer	Tambalabasi	Verde Island Passage, Batangas	Native	-	LC	Caringal et al. (2021)
	Gmelina arborea Roxb.	Gmelina	Verde Island Passage, Batangas	-	-	LC	Caringal et al. (2021)
	Premna congesta Merr. Syn. *P.serratifolia* L.	Alakaag	Cantipla, Cebu	Native	-	LC	Cadiz & Buot (2009)
	Stachytarpheta jamaicensis (L.) Vahl	Jamaica Vervain	Verde Island Passage, Batangas	-	-	LC	Caringal et al. (2021)

	Family & scientific name	Common name	Location	Endemicity	Conservation status		References
					DAO 2017-11	IUCN	
	Tectona philippinensis Benth. & Hook.f.	Philippine Teak	Verde Island Passage, Batangas	Endemic	EN	EN	Caringal et al. (2021)
	Vitex parviflora Juss.	Molave	Mount Lantoy, Cebu; Verde Island, Batangas	Native	EN	LC	Lillo et al. (2019); Caringal et al. (2021)
	Vitex quinata (Lour.) F.N. Williams	Kalipapa Sau, kulipapa, Hamulawen	Basey, Samar	Native	-	LC	Quimio (2016); Villanueva et al. (2021b)
	Vitex turczaninowii Merr. Syn. *Viticipremna philippinens*is (Turcz.) H.J. Lam.	Lingo-lingo	Mount Tabunan, Cebu; Parana, Samar	Native	-	LC	Cadiz & Buot (2010); Villanueva et al. (2021a)
30	**Lauraceae**						
	Alseodaphne malabonga (Blanco) Kosterm. Syn. *Nothaphoebe umbelliflora* (Blume)	Malabunga, Yaban	Verde Island Passage, Batangas	Native	-	LC	Caringal et al. (2021)
	Cinnamomum cebuense Kosterm.	Kaningag, Cebu Kalingag	Cantipla, Cebu; Mount Lantoy, Cebu	Endemic	EN	EN	Cadiz & Buot (2009); Lillo et al. (2019)
	Cinnamomum mercadoi S.Vidal	Mercadoi, Kalingag	Mount Lantoy, Cebu; Basey, Samar	Endemic	OTS	LC	Quimio (2016); Lillo et al. (2019); Villanueva et al. (2021b)
	Cryptocarya ampla Merr.	Bagarilau	Mount Lantoy, Cebu	Endemic	VU	LC	Lillo et al. (2019)
	Dehaasia triandra Merr. Syn. *D. Incrassata* (Jack) Nees	Makuhay	Verde Island Passage, Batangas	Native	-	LC	Caringal et al. (2021)
	Litsea tomentosa Blume	Bakan-mabolo	Mount Tabunan, Cebu	Native	-	LC	Cadiz & Buot (2010)
31	**Malvaceae**						
	Bombax ceiba DC.	Malabulak, Red Silk Cottontree	Verde Island Passage, Batangas	Native	-	LC	Caringal et al. (2021)
	*Camptostemon philippinensis (*S. Vidal) Becc.	Gapas-gapas, Dandulit	Basey, Samar	Native	EN	EN	Quimio (2016); Villanueva et al. (2021b)
	Colona serratifolia Cav.	Anilao	Verde Island Passage, Batangas	Native	-	LC	Caringal et al. (2021)
	Kleinhovia hospita Linn.	Tan-ag	Paranas, Samar	Native	-	LC	Villanueva et al. (2021a)
	Pterocymbium tinctorium (Blanco) Merr.	Taluto	Mount Tabunan, Cebu	Endemic	-	LC	Cadiz & Buot (2010); Caringal et al. (2021)
	Pterospermum diversifolium Blume	Bayo, Bayok	Verde Island Passage, Batangas	Native	-	LC	Caringal et al. (2021)
	Thespesia populnea (Linn.) Soland. Ex Correa	Banalo, Portia Tree	Verde Island Passage, Batangas	Native	-	LC	Caringal et al. (2021)
	Urena lobata L.	Dalupang, Kulotan, Caesar Weed	Verde Island Passage, Batangas	-	-	LC	Caringal et al. (2021)
32	**Marantaceae**						
	Phrynium minutiflorum Suksathan & Borchs.	Hagikhik (Bicol-Catanduanes)	Paranas, Samar	Endemic	VU	-	Villanueva et al. (2021a)
33	**Meliaceae**						
	Aglaia lawii (Wight) Saldanha & Ramamoorty	Talisayan, Aglaia	Mount Tabunan, Cebu	Native	-	LC	Cadiz & Buot (2010)
	Aglaia rimosa (Blanco) Merr.	Balubar, Bayanti	Paranas, Samar	Native	OTS	NT	Villanueva et al. (2021a)
	Chisocheton cumingianus Harms	Balukang, Balukanag	Basey, Samar	Native	-	LC	Quimio (2016); Villanueva et al. (2021b)
	Melia azedarach Linn.	Bagalunga, Chinaberry	Verde Island Passage, Batangas	Native	-	LC	Caringal et al. (2021)
	Sandoricum vidalii Merr.	Malasantol	Basey, Samar	Endemic	-	VU	Quimio (2016); Villanueva et al. (2021b)
34	**Moraceae**						
	Artocarpus blancoi (Elm.) Merr.	Antipolo	Mount Tabunan, Cebu; Calicoan, Guiuan	Endemic	-	LC	Cadiz & Buot (2010); Fernandez et al. (2020)
	Artocarpus odoratissimus Blanco	Marang	Mount Tabunan, Cebu	-	-	NT	Cadiz & Buot (2010)
	Artocarpus rubrovenius Warb.	Tugop, Kalulot	Calicoan, Guiuan; Taft, Eastern Samar; Paranas, Samar	Endemic	OTS	-	Fernandez et al. (2020); Obeña et al. (2021); Villanueva et al. (2021a)

	Family & scientific name	Common name	Location	Endemicity	Conservation status		References
					DAO 2017-11	IUCN	
	Ficus ampelas Burm.f.	Upling-gubat	Mount Tabunan, Cebu; Calicoan, Guiuan; Paranas, Samar	Native	-	LC	Cadiz & Buot (2010); Fernandez et al. (2020); Villanueva et al. (2021a)
	Ficus congesta Roxb.	Malatibig	Cantipla, Cebu	Native	-	LC	Cadiz & Buot (2009)
	Ficus drupacea Thunb. *Var. Drupacea*	Payapa, Nonok, Brown Woolly Fig	Verde Island Passage, Batangas	Native	-	LC	Caringal et al. (2021)
	Ficus linearifolia Elmer	Tabog	Mount Tabunan, Cebu	Endemic	-	LC	Cadiz & Buot (2010)
	Ficus minahassae (De Vriese & Teijsm.) Miq.	Hagimit	Mount Tabunan, Cebu; Calicoan, Guiuan	Endemic	-	LC	Cadiz and Buot (2010); Fernandez et al. (2020)
	Ficus nota (Blanco) Merr.	Tibig	Mount Tabunan, Cebu	Native	-	LC	Cadiz & Buot (2010)
	Ficus odorata (Blanco) Merr.	Pakiling	Mount Tabunan, Cebu	Endemic	-	LC	Cadiz & Buot (2010)
	Ficus septica Burm. F.	Hawili, Labnog	Mount Tabunan, Cebu	Native	-	LC	Cadiz & Buot (2010)
	Ficus stipulosa Miq. Syn. *F. Caulocarpa* (Miq.)	Dalakit	Calicoan, Guiuan	Native	-	LC	Fernandez et al. (2020)
	Ficus sumatrana Mig. Var. *Microsyce* Corner	Baleteng-ibon, Baleteng-liitan	Verde Island Passage, Batangas	Native	-	LC	Caringal et al. (2021)
	Ficus ulmifolia Lam	Is-is	Verde Island Passage, Batangas	Endemic	-	VU	Caringal et al. (2021)
	Ficus variegata Blume	Tangisang Bayawak	Mount Tabunan, Cebu	Native	-	LC	Cadiz & Buot (2010); Caringal et al. (2021)
	Streblus asper Lour.	Kalios	Verde Island Passage, Batangas	Native	-	LC	Caringal et al. (2021)
	Streblus ilicifolius (Vid.) Corner syn. *Taxotrophis ilicifolia*	Kuyos-kuyos	Verde Island Passage, Batangas	Native	-	LC	Caringal et al. (2021)
35	**Myricaceae**						
	Morella javanica (Blume) I.M.Turner [=*Myrica javanica* Blume]	Hindang	Basey, Samar	Native	-	LC	Quimio (2016); Villanueva et al. (2021b)
36	**Myristicaceae**						
	Horsfieldia ardisiifolia (A.DC.) Warb.	Dagoan, Tigan-tigan	Paranas, Samar	Endemic	-	VU	Villanueva et al. (2021a)
	Horsfieldia samarensis W.J.de Wilde	Samar Yabnob	Paranas, Samar	Endemic	VU	CR	Villanueva et al. (2021a)
	Knema stellata ssp. Stellata	Durogo, Panigan	Paranas, Samar	Native	-	VU	Villanueva et al. (2021a)
	Myristica agusanensis Elmer	Agusan Duguan	Mount Tabunan, Cebu	Endemic	-	NT	Cadiz & Buot (2010)
	Myristica laevis subsp. *Laevis* de Wilde	-	Basey, Samar	Endemic	-	VU	de Wilde (1997); Villanueva et al. (2021b)
	Myristica philippinensis Gand.	Duguan	Basey, Samar	Endemic	OTS	-	Quimio (2016); Villanueva et al. (2021b)
	Myristica pilosigemma W.J.de Wilde	-	Paranas, Samar	Endemic	OTS	CR	Villanueva et al. (2021a)
37	**Myrsinaceae**						
	Discocalyx euphlebia Merr.	Dikai-dikaian	Cantipla, Cebu	Endemic	-	EN	Cadiz & Buot (2009)
38	**Myrtaceae**						
	Eugenia tulanan Merr. [= *Jossinia tulanan* (Merr.) Merr.]	Tulanan	Basey, Samar	Endemic	-	EN	Quimio (2016); Villanueva et al. (2021b)
	Psidium guajava L.	Guava	Verde Island Passage, Batangas	-	-	LC	Caringal et al. (2021)
	Syzygium mindorense (C.B.Rob.) Merr	Butor	Verde Island Passage, Batangas	Endemic	-	VU	Caringal et al. (2021)
	Syzygium hutchinsonii (C.B. Robinson) Merr.	Malatambis	Basey, Samar	Endemic	-	CR	Quimio (2016); Villanueva et al. (2021b)
	Syzygium striatulum (C.B. Rob.) Merr.	Malaruhat Sapa	Basey, Samar	Endemic	-	VU	Quimio (2016); Villanueva et al. (2021b)
	Syzygium trianthum (Merr.) Merr.	Tubal	Cantipla, Cebu	Endemic	-	EN	Cadiz & Buot (2009)
	Tristania micrantha Merr.	Tiga	Basey, Samar	Endemic	-	EN	Quimio (2016); Villanueva et al. (2021b)

	Family & scientific name	Common name	Location	Endemicity	Conservation status		References
					DAO 2017-11	IUCN	
	Tristaniopsis decorticata (Merr.) Wilson & Waterhouse	Malabayabas	Mount Lantoy, Cebu	Endemic	VU	LC	Lillo et al. (2019)
39	**Opiliaceae**						
	Champereia manillana Blume	Garimo, Liyong-liyong	Mount Tabunan, Cebu	Native	-	LC	Cadiz & Buot (2010)
40	**Phyllanthaceae**						
	Antidesma ghaesembilla Gaertn. Var. *Ghaesembilla*	Binayuyo	Verde Island Passage, Batangas	Native	-	LC	Caringal et al. (2021)
	Antidesma pentandrum (Blanco) Merr. Syn. *A. Montanum* Blume	Bignai-pogo	Verde Island Passage, Batangas	Native	-	LC	Caringal et al. (2021)
	Breynia cernua (Poir.) Muell.-Arg.	Matang-ulang	Mount Tabunan, Cebu	Native	-	LC	Cadiz & Buot (2010)
	Breynia vitis-idaea (Burm. F.)	Matang-hipon	Verde Island Passage, Batangas	Native	-	LC	Caringal et al. (2021)
	Bridelia glauca Blume	Anislag	Calicoan, Samar; Paranas, Samar	Native	-	LC	Fernandez et al. (2020); Villanueva et al. (2021a)
41	**Rubiaceae**						
	Antherostele grandistipula	Kurudan	Basey, Samar	Endemic	EN	VU	Obico & Alejandro (2013); Villanueva et al. (2021b)
	Antherostele samarensis Obico & Alejandro		Basey, Samar	Endemic	CR	-	Obico & Alejandro (2013); Villanueva et al. (2021b)
	Antirhea livida Elmer	Lumangog	Basey, Samar	Endemic	VU	VU	Quimio (2016); Villanueva et al. (2021b)
	Atractocarpus obscurinervius (Merr.) Puttock	Kalanigi	Cantipla, Cebu	Endemic	CR	VU	Cadiz & Buot (2009)
	Dolicholobium philippinense Trenteuse	-	Cantipla, Cebu	Endemic	-	NT	Cadiz & Buot (2009)
	Guettarda speciosa Linn.	Banaro	Verde Island Passage, Batangas	Native	-	LC	Caringal et al. (2021)
	Mussaenda philippica A. Rich	Kahoy-dalaga	Verde Island Passage, Batangas	Endemic	-	LC	Caringal et al. (2021)
	Neonauclea formicaria Elm.	Hambabalud, Ambabalod	Calicoan, Guiuan; Paranas, Samar; Taft, Eastern Samar; Basey, Samar	Endemic	-	LC	Quimio (2016); Fernandez et al. (2020); Obeña et al. (2021); Villanueva et al. (2021a, b)
	Tarenna littoralis Merr. Syn. *Coptosperma littorale*	Bosiling-dagat	Verde Island Passage, Batangas	Endemic	-	LC	Caringal et al. (2021)
	Timonius appendiculatus Merr.	Upong-upong, Pututan	Basey, Samar	Endemic	-	VU	Quimio (2016); Villanueva et al. (2021b)
42	**Rutaceae**						
	Lunasia amara Blanco	Lunas	Mount Tabunan, Cebu	Native	-	LC	Cadiz & Buot (2010)
43	**Sapindaceae**						
	Dimocarpus foveolatus (Radlk.) Leenh	Mahugis,Pamirigin	Verde Island Passage, Batangas	Endemic	-	EN	Caringal et al. (2021)
	Dimocarpus longan Lour. *Ssp. Longan var. Malesianus*	Alupag Lalaki, Longan Tree	Mount Tabunan, Cebu	-	-	NT	Cadiz & Buot (2010)
	Dodonaea viscosa (Linn.) Jacquin	Kalapinay	Verde Island Passage, Batangas	Native	-	LC	Caringal et al. (2021)
	Elattostachys verrucosa (Blume) Radlk.	Baniwi	Mount Tabunan, Cebu	Native	-	LC	Cadiz & Buot (2010)
	Gloeocarpus patentivalvis (Radlk.) Radlk.	Tamaho, Igiw	Paranas, Samar	Endemic	EN	NT	Villanueva et al. (2021a)
	Guioa discolor Radlk.	Alahan-puti	Paranas, Samar	Endemic	VU	VU	Villanueva et al. (2021a)
	Harpullia arborea (Blanco) Radlk.	Puwas, Uwas	Verde Island Passage, Batangas	Native	-	LC	Caringal et al. (2021)
	Litchi chinensis Sonn. Subsp. *Philippinensis* (Radlk.) Leenh	Alupag	Mount Lantoy, Cebu	Native	VU	VU	Lillo et al. (2019)
	Lepisanthes fruticosa (Roxb.) Leenh.	Linawnaw	Mount Tabunan, Cebu	Native	-	LC	Cadiz & Buot (2010)

	Family & scientific name	Common name	Location	Endemicity	Conservation status		References
					DAO 2017-11	IUCN	
	Pometia pinnata Forst.	Malugay-liitan	Mount Tabunan, Cebu	Native	-	LC	Cadiz & Buot (2010)
44	**Sapotaceae**						
	Manilkara fasciculata (Warb.) H.J.Lam & Maas Geest.	Patsaragon	Taft, Eastern Samar; Paranas, Eastern Samar	Native	-	VU	Obeña et al. (2021); Villanueva et al. (2021a)
	Mimusops parvifolia R. Br. Syn. *M. Elengi* L.	Bansalagin	Cantipla, Cebu	-	-	LC	Cadiz & Buot (2009)
	Palaquium elliptilimbum Merr.	Alakaak-tilos	Cantipla, Cebu	Endemic	-	EN	Cadiz & Buot (2009)
	Palaquium elongatum Merr.	Long-leaved Nato	Paranas, Samar	Endemic	-	EN	Villanueva et al. (2021a)
	Palaquium gigantifolium Merr.	Alakaak, Alaka	Cantipla, Cebu	Endemic	-	NT	Cadiz & Buot (2009)
	Palaquium luzoniense (Fern.-Villar) S. Vidal	Nato	Mount Lantoy, Cebu; Calicoan, Guiuan; Basey, Samar	Native	VU	VU	Quimo (2016); Lillo et al. (2019); Fernandez et al. (2020); Villanueva et al. (2021b)
	Planchonella velutina (Elmer) H.J.Lam [= *Pouteria velutina* (Elmer) Baehni]	Amahit, Wakatan	Basey, Samar	Endemic	-	NT	Quimio (2016); Villanueva et al. (2021b)
45	**Simaroubaceae**						
	Harrisonia perforata (Blco.) Merr.	Mamikil, Laiya	Verde Island Passage, Batangas	Native	-	LC	Caringal et al. (2021)
46	**Stemonuraceae**						
	Gomphandra fernandoi Schori & Utteridge	Fernando Mabunot	Paranas, Samar	Endemic	VU	VU	Villanueva et al. (2021a)
	Gomphandra mappioides Valeton	-	Paranas, Samar	Native	-	LC	Villanueva et al. (2021a)
47	**Thymelaeaceae**						
	Aquilaria cumingiana (Decne.) Ridl.	Butlo, Lapnisan, Agar	Calicoan, Samar; Paranas, Samar	Native	VU	VU	Fernandez et al. (2020); Villanueva et al. (2021a)
48	**Urticaceae**						
	Oreocnide rubescens (Blume) Miq.	Lingatong, Kalulit	Paranas, Samar	Native	-	LC	Villanueva et al. (2021a)

Conservation status: CD—Conservation Dependent | DD—Data Deficient | OT—Other Threatened Species | LC—Least Concern | VU—Vulnerable | EN—Endangered | CR—Critically Endangered | NT—Near Threatened).

updated based on recent activities since the previous assessment.

The island of Samar, where SINP and GMRPLS are located, has been subjected to anthropogenic pressures such as timber cutting due to extensive logging, rattan extraction, and kaingin extraction (clearing of land through slash-and-burn agriculture) (Fernandez et al. 2020; Obeña et al. 2021; Villanueva et al. 2021a). Mount Cantipla (Cadiz & Buot 2009), Mount Tabunan (Cadiz & Buot 2010), Mount Lantoy (Lillo et al. 2019, 2021) forest in Cebu and Verde Island Passage in Batangas (Caringal et al. 2021) have been harmed by illegal logging and land use change activities. This is indeed true as also reported in several studies (Dirzo & Raven 2003; Rodrigues et al. 2006; Wright 2010; Croteau & Mott 2011). A variety of human activities, including habitat destruction, logging operations, shifting cultivation, fragmentation and degradation, pollution, the introduction of non-native species, and over-exploitation resulting from the conversion of natural vegetation such as forests into other uses amidst aggravating climate change issues, contribute to species endangerment and eventual local plant extinctions in the tropics. Many dipterocarp species, for instance, are particularly vulnerable in Southeast Asia because they play a unique role in forest ecology and are highly valued for their timber (Ashton & Kettle 2012; Maycock et al. 2012), and hence, are prone to exploitation through overharvesting (Sodhi et al. 2004; Fernando et al. 2015; McKinney 1997). If these anthropogenic threats are not mitigated and prevented, the number of woody plant species will decline and likely become extinct in the future. In fact, Koh et al. (2004) predicted that 6,300 species would become endangered if their host species become extinct. This is critical in the context of our forests over limestone not only those in Samar Island and the entire Philippines, but throughout the tropics. The ecosystem is already in severe stress due to microhabitat agroclimatic challenges, thus, if other

Image 1. Critically Endangered (CR) species: a—*Hopea philippinensis* Dyer | b—*Shorea astylosa* Foxw. | c—*Hancea wenzeliana* (Slik) S.E.C. Sierra, Kulju & Welzen. © CONserve-KAIGANGAN.

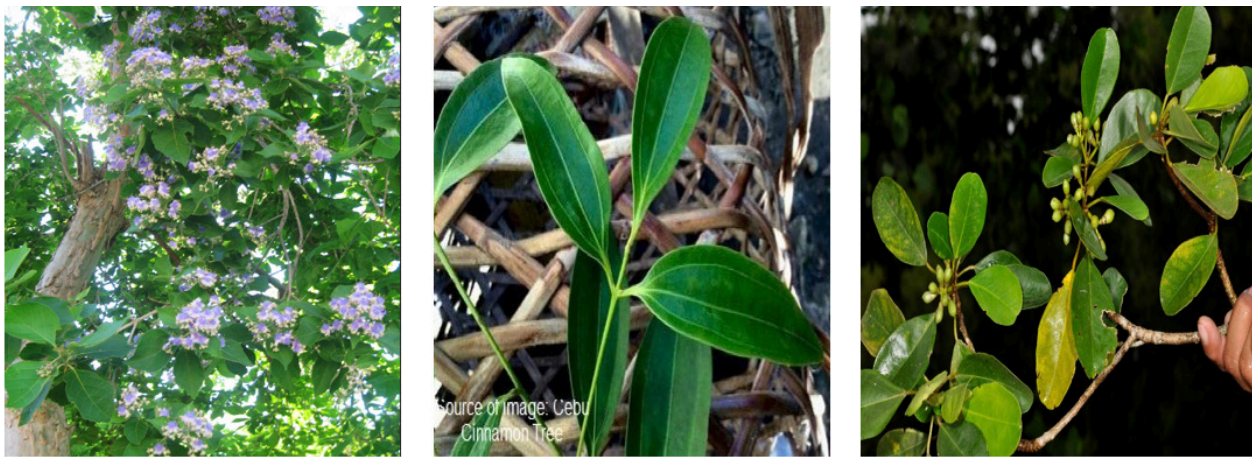

Image 2. Endangered (EN) species: a—*Tectona philippinensis* Benth. & Hook.f. | b—*Cinnamomum cebuense* Kosterm | c—*Camptostemon philippinense* (S. Vidal) Becc. © a—Caringal, A.; b—Cebu Cinnamon Tree FB page; c—Buot et al. 2022.

Image 3. Vulnerable (VU) species: a—*Aquilaria cumingiana* (Decne.) Ridl. | b—*Wallaceodendron celebicum* Koord. | c—*Shorea negrosensis* Foxw. © CONserve-KAIGANGAN.

anthropogenic disturbances occur, growth and survival of indigenous and endemic flora as well as fauna will be negatively affected. Also, these activities could have serious consequences on the livelihood of the local people who rely on them.

Unfortunately, the decline in number of some threatened woody plant species from various locations throughout the country has not yet been documented for inclusion in the Philippine red list or the IUCN. With 95% of plant species yet to be assessed on a global scale, new approaches to conservation assessment are urgently needed (Lughadha et al. 2005; Krupnick et al. 2009; Schatz 2009; Miller et al. 2012).

Notes on some threatened species in forests over limestone with economic importance

***Agathis philippinensis* Warb.**

Agathis philippinensis, commonly known as almaciga, can be found in the Philippines, Moluccas and Sulawesi. It is tapped and produces high quality of resin commercially known as Manila copal, which is used as raw material for varnish, lacquer, paper paint driers, linoleum, and ink, among others (Brown 1921; Samiano & Ella 2014). Due to the current high market demand for resin, sustained pressure from logging and resin collection, as well as unsustainable tapping methods, has contributed to declining populations of *A. philippinensis* in the Philippines (Jose 2018).

Conservation status: Vulnerable (DAO 2017-11).

***Antirhea livida* Elmer**

Antirhea livida is an endemic found in Luzon and Mindanao. Based on the IUCN (2022) assessment, this species will continue to decline due to the habitat-threatening effects of commodity-driven deforestation, shifting agriculture, urbanization, and losses from forest plantations and natural forest harvesting. Despite having a relatively large distribution, the species is still classified as Vulnerable due to its limited number of locations, small area of occupancy (AOO) value, and current threats to population and habitat quality. As such, immediate and active conservation measures must be considered to prevent the species from being pushed into a more threatened category in the future (IUCN 2022).

Conservation status: Vulnerable (DAO 2017-11 & IUCN).

***Aquilaria cumingiana* (Decne.) Ridl.**

Aquilaria cumingiana is a shrub or small tree which is found in the Philippines and Indonesia. *A. cumingiana* most famous product is agarwood, a resin containing heartwood produced from old and diseased trees (Tawan 2003) that is used for ornamentation, perfume and aromatic purposes (Swee 2008). Anthropogenic pressure on lowland primary forest within the range is reducing the amount of available habitat across its range (Lemmens & Bunyapraphatsara 2003).

Conservation status: Vulnerable (DAO 2017-11 & IUCN).

Camptostemon philippinensis

According to the IUCN (2022) assessment, this species is extremely rare and has a limited and patchy distribution in Indonesia and the Philippines. Throughout its range, it is severely threatened by the removal of mangrove areas for fish and shrimp aquaculture, as well as coastal development. It is estimated that there are less than 2,500 mature individuals left and there has been a least 30% decline in mangrove area within this species range since 1980 (one generation length).

Conservation status: Endangered (DAO 2017-11 & IUCN).

***Cinnamomum cebuense* Kosterm.**

Cinnamomum cebuense is an endemic tree species in the Philippines. Based on the assessment of IUCN (2022), the population of this species is expected to continuing declining due to the habitat threatening effects of commodity-driven deforestation, urbanization, unsustainable farming practices, and large-scale forestry operations. The species occurs naturally in Cebu Protected Landscape, providing some passive conservation. However, more proactive measures (e.g., artificial propagation, reintroduction to various arboreta in the country) should be implemented to prevent the species from becoming more threatened in the future.

Conservation status: Endangered (DAO 2017-11 & IUCN).

***Dipterocarpus gracilis* Blume**

Dipterocarpus gracilisis is native to the Philippines. The wood of this species is used for general building construction, particularly for house posts and frames, planking in lighters and ships, flooring, piling, bridge construction, wharves, and railroad ties (NRMC 1986). Due to continued deforestation and overexploitation, the DAO 2017-11 and IUCN (2022) classified this species as Vulnerable. The IUCN (2022) recommended that species harvest and trade be monitored, that remaining

habitat be protected, and that research into the genetic diversity of the species be conducted.

Conservation status: Vulnerable (DAO 2017-11 & IUCN).

***Dracontomelon dao* (Blanco) Merr. & Rolfe**

Dracontomelon dao species according to NRMC (1986), is used for sliced and rotary veneers, furniture making, cabinet work, tables, panels, boxes, and matches. Because of logging, kaingin making, and conversion of low elevation forest to agricultural lands, its ecological status has depleted.

Conservation status: Vulnerable (DAO 2017-11) / Least Concern (IUCN).

***Goniothalamus lancifolius* Merr.**

Goniothalamus lancifolius is an endemic tree. The species is assessed as endangered in IUCN due to population declines caused by illegal logging, shifting cultivation and land conversion. It is expected to decline as a result of these threats (IUCN 2022).

Conservation status: Endangered (DAO 2017-11 & IUCN).

***Guioa discolor* Radlk.**

Guioa discolor is an endemic tree. Based on the assessment of IUCN (2022), this species will continue to decline due to the habitat-threatening effects of commodity-driven deforestation, shifting agriculture, urbanization, and losses from forest plantation and natural forest harvesting. Immediate and active conservation measures are needed to keep the species from becoming more threatened in the future.

Conservation status: Vulnerable (DAO 2017-11 & IUCN).

***Hopea foxworthyi* Elmer**

Hopea foxworthyi is endemic. Its wood is used for general house construction, posts, bridge timber, and other wood applications that require strength and durability (NRMC 1986).

Conservation status: Critically Endangered (DAO 2017-11) / Endangered (IUCN).

***Hopea philippinensis* Dyer**

Hopea philippinensis is endemic to the Philippines. Based on NRMC (1986), this species is used locally for house posts and temporary railroad ties, but it is not widely used in construction due to its small size. However, *H. philippinensis* is depleted as a result of logging and kaingin making.

Conservation status: Critically Endangered (DAO 2017-11) / Endangered (IUCN).

***Kibatalia puberula* Merr.**

Kibatalia puberula is endemic to the Philippines. Based on IUCN (2022) information, *K. puberla* is restricted only in Samar and Leyte where it is known from dipterocarp forests or riverbanks, at elevation ranging from 100 to 250 meters asl. The species has a small area of occupancy and extent of occurrence, and it is declining due to threats to its habitat such as unlawful logging, poaching, charcoal making and firewood collection in Mt. Nacolod. These factors contribute to population decline of this species.

Conservation status: Endangered (DAO 2017-11 & IUCN).

***Litchi chinensis* Sonn.**

Litchi chinensis is native to the Philippines and New Guinea. According to Pareek (2016), this species is cultivated commercially in more than 20 countries. It is a high-value tropical fruit on the international fruit market (Miranda-Castro 2016). Because it is the best source of gutta-percha in the Philippines, destructive harvesting of the trees for gutta-percha in the past has severely eroded population levels (Brown 1920).

Conservation status: Vulnerable (DAO 2017-11 & IUCN).

***Palaquium luzoniense* (Fern.-Villar) S. Vidal**

Palaquium luzoniense is a native species in the Philippines and Sulawesi. The timber constitutes the majority of red nato in the Philippines. It is used to make furniture and cabinets, cigar boxes, and ship planking, as well as veneer and plywood. The latex of this species is used to make gutta-percha (Lemmens 1993).

Conservation status: Vulnerable (DAO 2017-11 & IUCN).

***Shorea almon* Foxw.**

Shorea almon is native to the Philippines and Borneo. The wood of *S. almon* is used for furniture and interior work of all kinds, boat planking and decking patterns, and for uses requiring a moderately hard and comparatively light wood with a beautiful ribbon figure. This species is in great demand for plywood both of rotary and sliced veneer. However, *S. almon* is now depleted due to logging and kaingin making (NRMC 1986).

Conservation status: Vulnerable (DAO 2017-11) / Near Threatened (IUCN).

***Shorea astylosa* Foxw.**

Shorea astylosa is a Philippine endemic. It is used for high-grade construction, bridges and wharves, mine timber and other installations requiring high strength and durability. However, due to logging and kaingin making, *S. astylosa* is now threatened (NRMC 1986).

Conservation status: Critically Endangered (DAO 2017-11) / Endangered (IUCN).

***Shorea contorta* Vidal**

Shorea contorta is a Philippine endemic. According to NRMC (1986), the wood of this species is used for general construction, veneer, hardboard and plywood making, and cabinet and furniture making. *S. contorta* is now depleted due to logging and kaingin making.

Conservation status: Vulnerable (DAO 2017-11) / Least Concern (IUCN).

***Shorea malibato* Foxw.**

Shorea malibato is endemic to the Philippines. This species as stated in NRMC (1986), this species is primarily used in permanent and general construction, ship framing, wharves, railroad ties, and other applications requiring strength and durability. *S. malibato* is now under threat due to logging and kaingin making.

Conservation status: Critically Endangered (DAO 2017-11) / Vulnerable (IUCN).

***Shorea negrosensis* Foxw.**

Shorea negrosensis is an endemic tree. It is commonly used for furniture and cabinet work of all kinds, veneer, hardboard and plywood, sash and millwork, boat planking and decking, and general building construction. However, the ecological status of this species is depleted due to logging and kaingin making (NRMC 1986).

Conservation status: Vulnerable (DAO 2017-11) / Least Concern (IUCN).

***Tectona philippinensis* Benth. & Hook.f.**

Tectona philippinensis is endemic to the Philippines. It is restricted only in coastal forests, littoral cliffs, and inland limestone ridges. This species is highly threatened due to its habitat preference, which is vulnerable to land conversion and development. It is also harvested for its timber and used to make fuelwood and charcoal (IUCN 2022).

Conservation status: Endangered (DAO 2017-11 & IUCN).

***Vitex parviflora* Juss.**

Vitex parviflora can be found throughout the Philippines. This wood of this species is used for construction work that requires strength and durability, such as railroad ties, bridge posts, etc. Its ecological status is depleted due to logging and kaingin making (NRMC 1986).

Conservation status: Endangered (DAO 2017-11) / Least Concern (IUCN).

Framework for sustainable conservation of threatened taxa

We developed and are proposing a framework for sustainable conservation of forests over limestone threatened species (Figure 5) to arrest their continuous decline. The framework illustrates an integrated practice of in situ and ex situ conservation strategies supportive of enhanced onsite protection and plant reintroduction (Buot 2008a,b,c; Kawelo et al. 2012; Miller et al. 2016; Tobias et al. 2021). If implemented with the aid of community participation, localized and national policy implementation, this could help save the species from extinction.

The framework emphasizes the enhancement of the ecosystem structure, function, and processes through practical and locally doable in situ and ex situ strategies. The integrity of the ecosystems rests in having a rich species composition and diversity (structure) and stable and dynamic ecosystem function and processes (Sulistiyowati & Buot 2013, 2016, 2020; Sulistiyowati et al. 2017). In situ strategy via the protected area systems, remain the country's best hope for preserving plant biodiversity and genetic resources onsite (Fernando et al. 2015), such as those found in some areas in Samar Island forests over limestone and many other types of forests in the country (e.g., Cebu's Mounts Tabunan, Cantipla, Lantoy) and in other parts of the world. There are still large tracts of forests over limestone which are not yet covered by national or even local protection (e.g., in GMRPLS).

Ex situ strategy, on the other hand, can be used to preserve groups of species that have experienced rapid declines as a result of anthropogenic activities, especially land use conversion. This conservation strategy can take the form of cultivation in botanic gardens and gene banks, nursery propagation, backyard gardening (Tobias et al. 2021), and establishment of forest groves and patches, to name a few. These forms of ex situ strategy will ensure the preservation of the species gene pool and can be used in reforestation and reintroduction in the natural habitat.

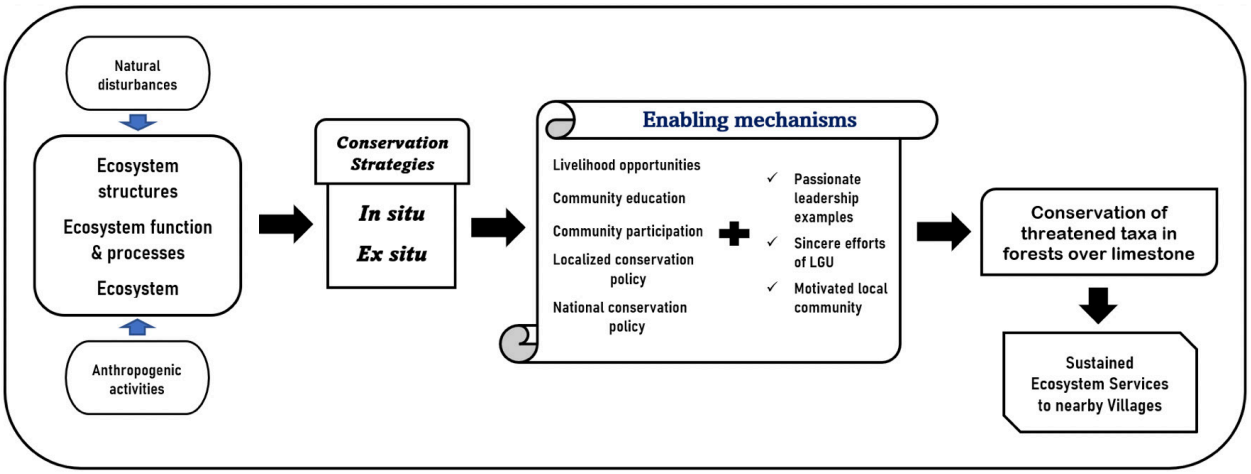

Figure 5. Framework for conservation of threatened taxa in forests over limestone.

Some enabling mechanisms are critical for the framework to be a success. In Figure 8, enabling mechanisms are divided into two columns. The left side enumerates the usual enabling strategies which have failed in many instances in the past. In this proposed framework, we included a PLUS (+) sign to illustrate the importance of the second column. As usual, there should be livelihood opportunities for the community (DENR-PAWB et al. 2003). The economic currency is of utmost importance for the community to understand the ecological contexts of conservation of the forests over limestone. Then, local community motivation is essential to participate in conservation strategies because success and failure of any task, is largely dependent on local people (Toit 2002), the empowered local people (Mathur 1997). Alongside this, there should be sustained forest conservation advocacy and the availability of appropriate community education and public awareness (CEPA) materials (Tolentino et al. 2019; Buot 2020; Buot & Buhay 2022). Additionally, coupled with localized conservation policies (Villanueva & Buot 2020) and national executive orders (Chanthavong & Buot 2019; Betts et al. 2020; Buot & Buhay 2022), we are positive to have a good enabling mechanism for conservation of threatened taxa.

The aforementioned had been done in the past and yet, we still are struggling to stop escalating depletion of plant resources leading to extinction. Hence, we thought of adding the second column of the Enabling Mechanism in Figure 5. We emphasize the PLUS sign (+). We envision the need for passionate leadership examples, sincere efforts of the local government units and a highly motivated local community to attain success in our conservation efforts. The success of these conservation strategies and initiatives is dependent on the extent and dedicated engagement of the innovator with the local government unit and the community members, themselves. The change agent/innovator should have the passion and sincere intentions to earn community's trust and attention.

CONCLUSION AND RECOMMENDATION

The findings of the study revealed that 40.81% of the threatened species found in forests over limestone in SINP, GMRPLS, Mt. Lantoy, Tabunan, Cantipla forest, and Verde Island Passage are indigenous and endemic to the Philippines. These species are primarily threatened by natural (typhoons, landslides, climate change) and anthropogenic activities such as unlawful logging and land conversion. There is an urgent need to address the steady increase in the number of these endangered species in recognition of their critical role in ecosystem structure and processes that would keep the integrity of the forests over limestone ecosystems in the country and in the world. A framework has been suggested in this paper to stop the continued species loss by integrating in situ and ex situ conservation strategies along with enabling mechanisms like enhancing livelihood, community awareness and participation to name a few, in order to stabilize species richness and diversity and hence, ecosystem function, processes, and dynamics. These will lead to the overall conservation of forests over limestone ecosystems, and hence, sustaining the life of the community in the vicinities through the sustained provision of ecosystem services.

The findings of this study will help achieve the

Sustainable Development Goals (SDGs) by protecting and conserving biodiversity, promoting, and sustainably managing resources, and preventing human pressures in forests over limestone in the Philippines.

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