

Biodiversity in Forests over Limestone in Paranas, Samar Island Natural Park (SINP), A UNESCO World Natural Heritage Site Nominee

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ABSTRACT.– This study provides a checklist of the vascular flora and terrestrial vertebrate fauna in forests over limestone in Paranas, Samar Island Natural Park (SINP), Philippines, a UNESCO World Natural Heritage Site nominee. Nine 20x20m plots and 18 line transects were established for the floral inventory. The faunal assessment was conducted in transects laid in three sites within Paranas. Secondary data was collected from published articles regarding biodiversity in Samar Island Natural Park (SINP). The list shows 99 plant species representing 63 genera and 44 families. Eighteen species were identified as non-endemic and 38 species were Philippine endemics. New island records of *Tectaria calcarea* (C. Presl) Copel., *Artocarpus rubrovenius* Warb. and *Hancea wenzeliana* (Slik) S.E.C.Sierra, Kulju & Welzen were also reported. Eleven plants are listed as endangered in the IUCN Red List and/or DENR DAO 2017-11. Also, 106 vertebrates were recorded in a faunal inventory, including 4 amphibians, 9 reptiles, 84 avifauna, and 9 mammal species, with overall endemism of 71 (67%). A new locality record of *Platymantis bayani* was noted in Paranas. Twenty-one vertebrate species were listed as threatened in the IUCN Red List and/or DENR DAO 2019-09. This biodiversity information strengthens the nomination of SINP as a UNESCO World Natural Heritage Site, as this supports SINP's outstanding universal value. The checklist is also essential for the formulation of policies and management strategies for the conservation and protection of *kaigangan* (forest over limestone).

KEY WORDS: ecotourism, endemic species, *kaigangan*, Paranas, Philippines, protected areas, threatened species, UNESCO World Natural Heritage

INTRODUCTION

Samar Island houses an extensive area of karsts (Restificar, 2006). Some of the karst landscapes are part of the Samar Island Natural Park (SINP), a forest reserve on the third-largest island of the Philippines. It was declared as a protected area under Proclamation No. 442. 2003, pursuant to the National Integrated Protected Areas System

(NIPAS) Act of 1992 (Republic Act No. 7586). It has a total land area of 330,300 hectares plus a buffer zone of 124,500 hectares. A forest over limestone is a forest formation type thriving on limestone karsts, which are outcrops mainly composed of calcium carbonate. Limestone karsts cover about 10% of the total land area of the Philippines and are notable for having high species endemism due to their unique flora and fauna (Fernando et al., 2008).

Recent biological assessments conducted in SINP by scientists have proven the richness of the biodiversity of the area. Floral (Quimio, 2016) and faunal (Patindol, 2016) assessments were conducted in five watersheds of SINP, where 212 tree species and 182 terrestrial vertebrate species were documented. Most of the tree individuals assessed were dipterocarps (Family Dipterocarpaceae). However, continuous forest fragmentation and destructive anthropogenic activities have led to a decline in biodiversity. Defining conservation priorities is of high importance since it safeguards biodiversity and ultimately halts biodiversity loss (Brooks et al., 2006).

The Key Biodiversity Areas (KBA) approach was initiated by the Philippine government to aid the agency and stakeholders prioritize conservation action and devise geographically specific strategies that protect the individual species and safeguard representative habitats (Edgar et al. 2008). Samar Island, as a Key Biodiversity Area, has its share of notable biodiversity. Early records in Merrill's Enumeration of the Philippine Flowering Plants (1923-1926) noted 406 endemic species, represented by 200 genera and 65 families in Samar Island (Madulid, 2000). Moreover, additional species of palms (Adorador and Fernando, 2017; 2019; Adorador et al., 2020), orchids (Meneses et al., 2018; Meneses and Cootes, 2019), *Pyrostria* (Alejandro et al., 2013), and *Gomphandra* (Schori and Utteridge, 2012) were recently documented. A total of 30 mammal (Heaney et al, 2010), 172 bird (eBird, 2021), 24 amphibian (Diesmos et al., 2015; Diesmos et al., 2020), and 31 snake (Leviton et al., 2018; Weinell et al., 2020) species from extensive checklists and recent faunal discoveries were recorded from Samar. Patindol (2016) assessed terrestrial

vertebrates from the municipalities of Taft, Can-avid, and Suribao in Eastern Samar, Basey in Samar, and Catubig in Northern Samar and documented 182 species including 18 amphibian, 23 reptile, 121 bird, and 20 mammal species.

To further enhance the protection of SINP, the area was nominated as a UNESCO World Natural Heritage Site. This is a huge opportunity and challenge for the stakeholders of SINP, as the UNESCO World Heritage Convention seeks the conservation of landscapes that possess *outstanding universal value*, which means that its significance should go beyond national boundaries and benefit all of humanity (Williams 2011).

Southeast Asia is composed of about 10% karst in terms of land area (Day and Ulrich, 2000). In this region, there are eight UNESCO World Natural Heritage Sites situated in terrestrial karst formations: Gunung Mulu National Park (Malaysia), Lorentz National Park (Indonesia), Dong Phrayayen-Khao Yai Forest Complex (Thailand), Thungyai-Hua Kha Khaeng Wildlife Sanctuaries (Thailand), Ha Long Bay (Vietnam), Phong Nha-Ke Bang National Park (Vietnam), Trang An Landscape Complex (Vietnam), and Puerto Princesa Subterranean River National Park (Philippines) (Clements, 2006; Day and Ulrich, 2010; Day, 2011; UNESCO, 2020). These natural heritage sites feature their rich and unique biodiversity as their outstanding universal values, including their scenic karst landforms. In the same way, SINP can contend to be included in this natural heritage list if it has enough data on its unique biodiversity, as well as on its physical characteristics such as geological features and processes. Information on biodiversity is crucial for the IUCN, the advisory body of the UNESCO World

Heritage Convention (WHC), to ensure the coverage and conservation of the World Heritage Sites (Williams, 2011).

The Assessment and Conservation of Forest over Limestone Ecosystem Biodiversity in Selected Municipalities of Samar Island Philippines (CONserve-KAIGANGAN) is a three-year research program of UPLB and Samar State University (SSU) which aims to assess and conserve the biodiversity in the forest over limestone ecosystems towards sustainable management of Samar Island, Philippines. One of the main goals of this program is to conduct floral and faunal assessments in two municipalities within SINP: Paranas and Taft. As a source of valuable biodiversity information, this study produced a checklist of Paranas flora and fauna, along with other existing baseline information about SINP that can support its worth as a natural treasure that transcends national boundaries.

Moreover, to qualify as a world natural heritage site, SINP should also have concrete policies and sustainable management strategies for its protection and conservation (UNESCO, 1972; Williams, 2011). Its administration should be well-represented by various stakeholders and site managers from different sectors and genders, as UNESCO promotes a human-rights based approach in managing world heritage properties (UNESCO World Heritage Committee, 2019). It should include local and national government units, peoples' organizations (POs), academic institutions, non-government organizations (NGOs), and more importantly, the local communities of the national park. Aside from providing information on biodiversity, the outputs of this checklist can also aid the formulation of science-based policies and regulations for the management of SINP. Through this list, localized efforts can also be organized and

targeted for the conservation of the threatened species and sustainable use of the economically important species.

SINP has already begun this action through some of its ecotourism initiatives. In the SINP Central Headquarters in Brgy. Tenani, Paranas, the office has an eco-lodge managed by the Protected Areas Superintendent (PASu). The lodge helps monitor the influx of visitors as it accommodates interested tourists and explorers. Moreover, the Paranas Eco-trail and Birding Site was launched last August 2019 by the Department of Tourism (DOT), DENR, local government units (LGUs), and POs (Amazona, 2019). Managed by the Tenani Association for Women and Development (TAWAD), the community-based ecotourism activity serves as a source of livelihood for the residents of Paranas while promoting the biodiversity of Samar *kaigangan*. This program is also assisted by Tour Guides and Boat Operators for River Protection and Environmental Development Organization (TORPEDO), another PO composed of boatmen and river guides.

To illustrate the outstanding universal value of SINP as a nominee of UNESCO World Natural Heritage status, on-site evidence of the biodiversity of SINP is needed. Thus, the baseline data from this study is highly significant for this pursuit as it globally highlights the protection and conservation of the biodiversity and landscapes of SINP. This study aims to provide new records and a checklist of the vascular plants and terrestrial vertebrate animals of the forest over limestone ecosystems in Paranas, a municipality situated in SINP, while highlighting the conservation concerns of its threatened species. This study also explained the importance of this biological assessment for the nomination of SINP for the UNESCO World Heritage Site.

MATERIALS AND METHODS

Study area

The study was conducted in Samar Island Natural Park (SINP), a forest reserve and a protected area in Samar Island, Philippines (Figure 1). SINP covers 37 municipalities and one city, including the municipality of Paranas, Samar. Samar is part of the Mindanao Pleistocene Aggregate Island Complex (PAIC), which also includes the islands of Leyte, Bohol, and Mindanao (Ong et al., 2002). Samar Island exhibits affinities with these islands in terms of its fauna, thus grouped as a single PAIC (Heaney, 1986; 1993; Vallejo, 2011). Paranas was chosen as the study site in SINP. It is a second-class municipality in the province of Samar with a human population of 30,557 (Philippine Statistics Authority, 2019).

Establishment of the sampling sites for floral and faunal inventory

The fieldwork for the inventory was conducted from October 1-5, 2019. The sampling sites were in the forest over limestone (locally known in Samar Island as *kaigangan*) ecosystems in Paranas, Samar.

Plots established were based on the biophysical characteristics of the area such as plant diversity heterogeneity, topographic attributes, and the presence of anthropogenic disturbances in the area. The quadrat or plot technique was used to assess the trees (≤ 1 m), while the line intercept technique was used for understory plant species. Nine 20x20 meter plots were established in Paranas (Fig. 1). Trees within each plot were noted and identified. For the understory species, two line transects per plot (a total of 18 transects) were laid within the 20x20 meter plots. Each transect had a length of five meters with one-meter intervals. Voucher specimens were collected

from the sampled plants in the field and were processed deposited at the Plant Biodiversity Division Herbarium (PBDH) of the University of the Philippines Los Baños (UPLB), Laguna for proper identification and documentation. Fern Flora of the Philippines (Vol 1,2, and 3) were used in identifying fern species. These were compared with the collections of PBDH and from available online resources such as “Co’s Digital Flora of the Philippines” (Pelser et al. 2011) including a recent botanical assessment in SINP (Quimio, 2016). Furthermore, experts from the Philippine National Museum were consulted to identify the unknown plant specimens.

For the assessment of animal diversity, fieldwork for the vertebrate fauna inventory was conducted at three sites: a transect was laid in Barangay (Brgy.) San Isidro, Paranas, while the other two were in Brgy. Tenani, Paranas. Various trapping methods were employed for the capture of animals following the DENR Manual on Biodiversity Assessment and Monitoring System for Terrestrial Ecosystems (Cruz et al., 2017). All four major land vertebrate groups (reptiles, amphibians, birds, and mammals) were covered in this inventory. Significant features of the specimens were noted, and they were photographed to aid in their identification. Mist nets were strategically set to capture bats from around 1700-0500 h, for a total of 9 net-nights in 5 days. Bird observations were made whenever possible during the day while walking through the established transects to set up cage traps and look for reptiles. Purposive sampling was employed to capture and observe reptiles and amphibians from 0700h to 0900h, 1100h to 1300h, and 1900h to 2100h, for an average observation of 5-6 hours per day for 5 days. Lastly, a total of 62 trap-nights were set using cage

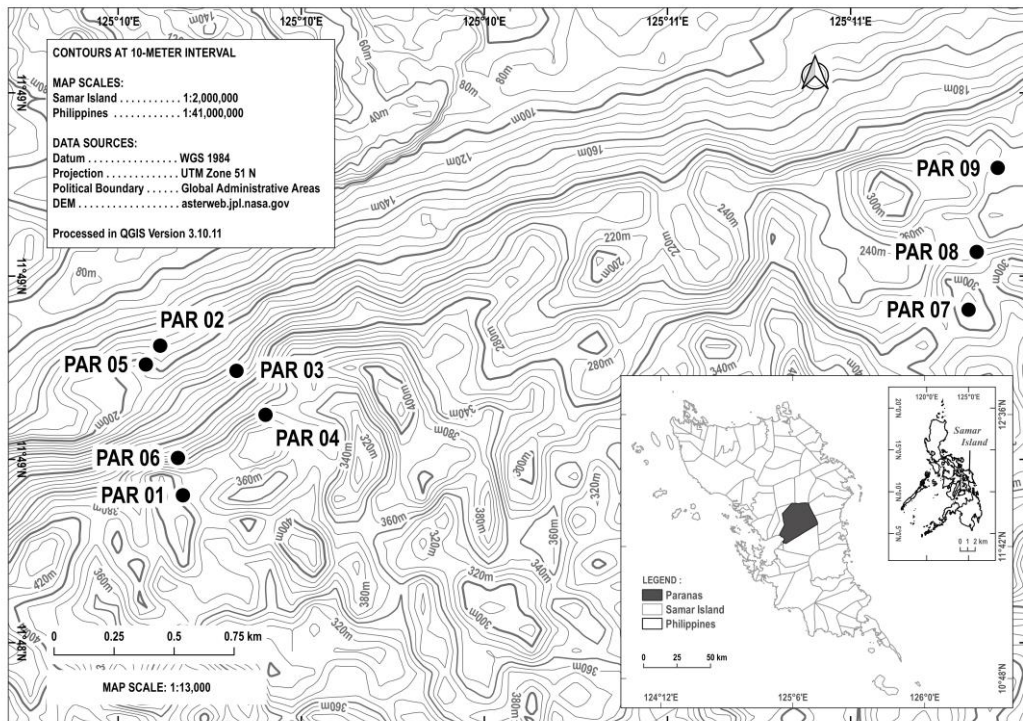


FIGURE 1. Map of sampling plots in Paranas, Samar Island Natural Park (SINP), Philippines. Established plots are marked with black circles.

traps baited with roasted coconut covered in peanut butter to capture small non-volant mammals.

Several mist nets and rat traps were set near the SINP Headquarters at about 190 masl on the current ecotourism trail marked as the starting point of one of the established faunal transects. Anthropogenic disturbances were observed such as the presence of a plant nursery, with a few occurring coconut trees and rattan on the lower portion of the trail. Other traps were set on strategic locations at higher elevations where there were fewer anthropogenic disturbances, although traces of past logging were observed at the end of the transect at about 385 masl. Another faunal transect was established at 160-350 masl on an older ecotourism trail which showed less

anthropogenic disturbances, but landslides were observed near the end of the transect. A third faunal transect was established in Barangay San Isidro, Paranas, Samar at 210-246 masl where a small area cleared for planting agricultural crops was observed at 232 masl. Availability of water was scarce for all the transects surveyed. Several sinkholes were also present where some animals such as bats and rats were observed.

Secondary data collection

Published literature, monographs, and other checklists regarding biodiversity in Samar Island Natural Park (SINP) were also reviewed in relation to species occurrence and endemism for both flora and fauna. The endemic status of each species was verified by consulting available checklists, related publications, and online resources.

RESULTS AND DISCUSSION

Floral diversity

Table 1 shows the list of plants inventoried in Paranas, Samar based on field collections and published literature. Ninety-three (99) plant species representing 63 genera and 44 families were documented. Among these species, 84 were identified at least up to the family level, composed of 72 angiosperm, eleven pteridophyte, and one lycophyte species. The plant families with the most species represented were Arecaceae (11 spp.), Euphorbiaceae (5 spp.), Diperocarpaceae (5 spp.), Tectariaceae (4 spp.) Myristicaceae (4 spp.), Araceae (4 spp.), and Sapotaceae (3 spp.), Rubiaceae (3 spp.). Several families were represented by two species, such as Annonaceae, Clusiaceae, Moraceae, Thymelacaceae, Sapindaceae, Apocynaceae, Acanthaceae, and Stemonuraceae. Nine genera were noted to have more than one species represented: *Calamus*, *Pinanga*, *Horsefieldia*, *Alocasia*, *Hopea*, *Garcinia*, *Kibatalia*, *Gomphandra*, and *Palaquium*. Thirty-eight species were identified as Philippine endemics, while 18 are native but non-endemic species; 15 could not be identified to species level (Table 1). The list also shows the first record in Paranas, Samar Island of *Tectaria calcarea* (C. Presl) Copel (Fig. 2.A), *Artocarpus rubrovenius* Warb. (Fig. 2.B) and *Hancea wenzeliana* (Slik) S.E.C.Sierra, Kulju & Welzen (Fig. 2.C). *T. calcarea* (C. Presl) Copel is reported to be in the islands of Polillo, Bohol, and Leyte (Copeland EB, 1960; Pelser et al., 2011-onwards). *A. rubrovenius* has a known distribution throughout Luzon, while *H. wenzeliana* is known to be distributed in Mindanao, Philippines (Pelser et al., 2011-onwards).

Compared with other studies of forest over limestone flora in the Philippines, the

list shares some similarities in terms of plant taxa representation. For instance, in Cebu Island, the karst flora is mostly represented by Moraceae and Araceae in Mt. Tabunan (Cadiz and Buot, 2010), and Sapotaceae and Moraceae in Mt. Lantoy (Lillo et al., 2019a). There was also notable similar plant family representation of Moraceae, Euphorbiaceae, and Clusiaceae in Dinagat Island in northeastern Mindanao (Lillo et al., 2019b). Meanwhile, at the genus level, *Garcinia* was highly represented in Mt. Tabunan (Cadiz and Buot, 2010), and *Palaquium* in Mt. Lantoy (Lillo et al., 2019a).

The forest over limestone flora of Paranas, SINP shares similarity with some plant taxa in other forests over limestone of Southeast Asia. In Malaysia, Gunung Mulu National Park has its forests over limestone ecosystems dominated by the following plants families (in terms of basal area and species abundance): Dipterocarpaceae, Fabaceae, Euphorbiaceae, Meliaceae and Myrtaceae. Some genera in Gunung Mulu that also occur in SINP include *Shorea* and *Palaquium* (Proctor et al., 1983). Meanwhile, in Vietnam, the limestone flora in Ben En National Park is mostly represented by Lauraceae, Fabaceae, Fagaceae, Meliaceae, and Sapindaceae (Nguyen, 2015). Based on taxa representation of the two forests over limestone ecosystems, SINP shares more similarities with Gunung Mulu National Park than with Ben En National Park.

Notable plant species

Among the vascular plant species recorded in Paranas, Samar, 39 have a conservation status in the International Union for Conservation of Nature and Natural Resources (IUCN) Red List of Threatened Species (2020) and/or DENR Administrative Order (DAO) 2017-11, also known as the Updated National List of Threatened Philippine Plants and Their

TABLE 1. List of vascular plants inventoried in Paranas, Samar Island, Philippines.

PLANT GROUP	FAMILY	SCIENTIFIC NAME	COMMON NAME	HABIT*	SOURCES			
					EXSICCATA	REFERENCES		
Pteridophyta ¹	Selaginellaceae	<i>Selaginella</i> sp.	No recorded common name	H	Obeña 7136 (PBDH)	Pelsner et al. (2011- onwards)		
	Marattiaceae	<i>Angiopteris</i> sp.	Palko	T	Obeña 7152 (PBDH)			
	Pteridaceae	<i>Pteris ensiformis</i> Burm.	No recorded common name	H	Obeña 7042 (PBDH)			
	Blechnaceae	<i>Ocniopteris egregia</i> (Copel.)	No recorded common name	H	Obeña 7051, Obeña 7058 (PBDH)			
	Thelypteridaceae	<i>Pronephrium rhombum</i> (Christ) Holttum	No recorded common name	H	Obeña 7053 (PBDH)			
	Dryopteridaceae	<i>Polystichum moluccense</i> T. Moore	No recorded common name	H	Obeña 7134 (PBDH)			
	Lomatopsidaceae	<i>Cyclophellis crenata</i> (Fée) C. Chr.	Lukdo/ Blue green fern	H	Obeña 7111 (PBDH)			
	Tectariaceae	<i>Tectaria alvirostrata</i> M.G. Price	No recorded common name	H	Obeña 7048 (PBDH)			
		<i>Tectaria calcarea</i> (C. Presl) Copel.	No recorded common name	H	Obeña 7046, Obeña 7057 (PBDH)			
		<i>Tectaria dissecta</i> (G. Forst.) Lellinger	Nito	H	Obeña 7126 (PBDH)			
		<i>Tectaria psomiocarpa</i> S.Y. Dong	No recorded common name	H	Obeña 7050 (PBDH)			
	Polypodiaceae	<i>Leptochilus macrophyllus</i> (Blume)	No recorded common name	H	Obeña 7054 (PBDH)			
	Spermatophyta: Angiospermae ²	Lauraceae	<i>Nothaphoebe leytenensis</i> (Elmer) Merr.	Wakatan	T		Obeña 7149 (PBDH)	Pelsner et al. (2011- onwards)
		Annonaceae	<i>Goniothalamus cf. lanceifolius</i> Merr.	No recorded common name	T			
		<i>Orophea cumingiana</i> S. Vidal	Amúnat, Karasákát, Lanuán, Lobantí, Poagan	S				
Myristicaceae		<i>Horsfieldia ardisifolia</i> (A.DC.) Warb.	No recorded common name	T				
		<i>Horsfieldia samarensis</i> W.J.de Wilde	No recorded common name	T				
		<i>Knema stellata</i> ssp. <i>stellata</i>	No recorded common name	T				
		<i>Myristica pilosigemma</i> W.J.de Wilde	No recorded common name	T				
Aristolochaceae		<i>Thottea tomentosa</i> (Blume) Ding Hou	No recorded common name	T				
Piperaceae		<i>Piper</i> sp.	Wenter	S	Obeña 7137 (PBDH)			
Araceae		<i>Alocasia</i> sp.	Alocasia sp.	H	Obeña 7100 (PBDH)			
		<i>Alocasia zebrina</i> Schott ex Van Houtte	Handuroy	H	Obeña 7118 (PBDH)			
		<i>Homalomena philippinensis</i> Engl.	Payaw	H	Obeña 7130 (PBDH)			
		<i>Schismatoglottis calyptrata</i> (Roxb.) Zoll. & Moritz	No recorded common name	S	Obeña 7140 (PBDH)			
Pandanaceae		unidentified	Bariw	T/ S		Pelsner et al. (2011- onwards)		
Arecaceae	<i>Calamus alatae</i> Fernando	Ulisti (Biliran), Ulisti (Samar), Inhian (Agusan del Sur)	T					
	<i>Calamus discolor</i> C. Mart.	Hamlis, Kumaboy (Tagalog), Ubanon (Cebu, Bisaya)	T		Pelsner et al. (2011- onwards)			
	<i>Calamus ochrolepis</i> (Becc.) W.J. Baker	No recorded common name	T			Pelsner et al. (2011- onwards)		

TABLE 1. (Continue)

PLANT GROUP	FAMILY	SCIENTIFIC NAME	COMMON NAME	HABIT*	SOURCES	
					EXSICCATA	REFERENCES
		<i>Calamus symphysiopus</i> C. Mart.	Balaoag (Manobo), Palanog	T		Pelser et al. (2011-onwards)
		<i>Calamus zollingeri</i> ssp. <i>merrillii</i>	No recorded common name	T		Adorador and Fernando, 2020
		<i>Calamus wariyanus</i> Adorador & Fernando	No recorded common name	T		
		<i>Caryota rumphiana</i> Mart.	Pugahan/ Tagabunga	T	Obeña 7133 (PBDH)	
		<i>Heterospathis intermedia</i> (Becc.) Fernando	Banga	T	Obeña 7107 (PBDH)	
		<i>Oreania zheze</i>	<i>bangga, bangga-igang</i> (Wary, Bisaya)	H		Adorador and Fernando, 2019
		<i>Pinanga copelandtii</i> Becc.	No recorded common name	T		Pelser et al. (2011-onwards)
		<i>Pinanga gruzoi</i> Adorador Fernando	No recorded common name	T		Adorador and Fernando, 2020
Orchidaceae		<i>Pseudaria samarana</i> Z.D. Meneses & Cootes	No recorded common name	H		Meneses ZD & Cootes, 2019
Marantaceae		<i>Phrynium minutiflorum</i> Suksathan & Borchs.	Hagikhiik (Wary)	S		Pelser et al. (2011-onwards)
Nepentaceae		<i>Nepenthes samar</i> Jebb & Cheek	No recorded common name	S		Pelser et al. (2011-onwards)
Clusiaceae		<i>Garcinia rubra</i> Merr.	Diis	T	Obeña 7115 (PBDH)	
Salicaceae		<i>Flacourtia</i> sp.	No recorded common name	T	Obeña 7145 (PBDH)	
Euphorbiaceae		<i>Codiaeum macgregorii</i> Merr.	Marumanga	T		
		<i>Codiaeum</i> sp.	No recorded common name	T	Obeña 7144 (PBDH)	
		<i>Tritaxix ixoroides</i> (C.B.Rob.) R.Y. Yu & Welzen	No recorded common name	T		
		<i>Hancea worzelliana</i> (Slik) S.E.C. Sierra, Kulju & Welzen	No recorded common name	T	Obeña 7103 (PBDH)	
		<i>Macaranga bicolor</i> Müll. Arg.	Pailig	T	Obeña 7127 (PBDH)	
Phyllanthaceae		<i>Bridelia glauca</i> Blume	Anislag	T	Obeña 7102 (PBDH)	
Fabaceae		<i>Wallacodendron celebicum</i> Koord.	Banuyo/ Salukigi	T	Obeña 7108 (PBDH)	
(Leguminosae)						
Moraceae		<i>Artocarpus rubroventris</i> Warb.	Tugop	T	Obeña 7147 (PBDH)	
		<i>Ficus ampelas</i> Burm.f.	Lanete	T	Obeña 7121 (PBDH)	
Urticaceae		<i>Oreocnide rubescens</i> (Blume) Miq.	Lingatong	T	Obeña 7123 (PBDH)	
Begoniaceae		<i>Begonia</i> sp.	Kulasinan	H	Obeña 7161 (PBDH)	
Casuarinaceae		<i>Gymnostoma rumphianum</i> (Miq.) L.A.S. Johnson	Agoho	T	Obeña 7099 (PBDH)	
		<i>Aglaia rimosa</i> (Blanco) Merr.	No recorded common name	T	Obeña 7143 (PBDH)	
Meliaceae		<i>Canarium hirsutum</i> Willd.	Milipili	T	Obeña 7125 (PBDH)	
Burseraceae		<i>Aquilaria cumingiana</i> (Decne.) Ridl.	Lapinsan/ Agar	T	Obeña 7098 (PBDH)	
Thymelaeaceae		<i>Gonythylus reticulatus</i> (Elmer) Merr.	Batuan	T		
		<i>Hopea philippinensis</i> Dyer	Gisok	T		
Dipterocarpaceae		<i>Hopea quisumbingiana</i> Gutierrez	No recorded common name	T	Obeña 7116 (PBDH)	Samar Island Natural Park Development Plan, 2007
		<i>Hopea samarensis</i> Gutierrez	No recorded common name	T		Samar Island Natural Park Development Plan, 2007
		<i>Shorea negrosensis</i> Foxw.	Lawaan na Pula (Takuban)	T	Obeña 7122 (PBDH)	
		<i>Shorea</i> sp.	Lawaan na Puti (Hamis or Busag)	T		
		unidentified	Yakal	T		
Anacardiaceae		<i>Mangifera monandra</i> Merr.	No recorded common name	T	Obeña 7151 (PBDH)	Samar Island Natural Park Development Plan, 2007

TABLE 1. (Continue)

PLANT GROUP	FAMILY	SCIENTIFIC NAME	COMMON NAME	HABIT*	SOURCES	
					EXSICCATA	REFERENCES
Supindaceae		<i>Gloeocarpus patenivahvis</i> (Radlk.) Radlk. in Engl.	No recorded common name	T		Samar Island Natural Park Development Plan, 2007
		<i>Guttoa discolor</i> Radlk.	No recorded common name	T		Samar Island Natural Park Development Plan, 2007
Cornaceae	Sapotaceae	<i>Mastixia</i> sp.	Tul-anan	T	Obeña 7148 (PBDH)	
		<i>Palaquium</i> cf. <i>elongatum</i>	No recorded common name	T	Obeña 7105 (PBDH)	
Apocynaceae		<i>Palaquium</i> sp. (1)	Bagotambis	T	Obeña 7129 (PBDH)	
		<i>Manikara fasciculata</i> (Warb.) H.J.Lam & Maas Geest.	Paisaragon	T		
		<i>Kibatalia merrilliana</i> Woodson	No recorded common name	T		Samar Island Natural Park Development Plan, 2007
		<i>Kibatalia puberula</i> Merr.	No recorded common name	T		Samar Island Natural Park Development Plan, 2007
Ebenaceae	Rubiaceae	<i>Diospyros</i> sp.	Hambabulud	T	Obeña 7045 (PBDH)	
		<i>Neonanctlea</i> sp.	Kamagong/ Bagonito	T	Obeña 7119 (PBDH)	
Lamiaceae	Acanthaceae	<i>Prismatomeris tetrandia</i> ssp. <i>tetrandia</i>	No recorded common name	S/T		Pelser et al. (2011-onwards)
		<i>Psychotria</i> sp.	No recorded common name	T	Obeña 7120 (PBDH)	
Araliaceae	Stemonuraceae	<i>Vitex turczaninowii</i> Merr.	Kolipapa	T		Pelser et al. (2011-onwards)
		<i>Strobilanthes bulusanensis</i> Elmer	No recorded common name	S		
		<i>Gymnostachyum affine</i> Nees	No recorded common name	S		
		<i>Polyscias nodosa</i> (Blume) Seem.	Bongliw	S/T	Obeña 7112 (PBDH)	Schori M & Uteridge TMA, 2012
Unknown		<i>Gomphandra fernandoi</i> Schori & Uteridge	No recorded common name	S/T		Pelser et al. (2011-onwards)
		<i>Gomphandra mappioides</i> Valetton	No recorded common name	S/T		
		unidentified	Barit	T	Obeña 7109 (PBDH)	
		unidentified	Buskayan	T	Obeña 7114 (PBDH)	
		unidentified	Sumol	T	Obeña 7146 (PBDH)	
		unidentified	Urukay	T	Obeña 7150 (PBDH)	
		unidentified	Bunguran Yakal	T	Obeña 7113 (PBDH)	
		unidentified	Anibong	T		
		unidentified	Karyota	T		
		unidentified	Katol	T		
		unidentified	Tan-ag	T		
		unidentified	Pamintaogon	T	Obeña 7128 (PBDH)	
		unidentified	Lukdo bato	U	Obeña 7163 (PBDH)	
		unidentified	No common name	U	Obeña 7059 (PBDH)	
		unidentified	Luta	U	Obeña 7138 (PBDH)	
		unidentified	Marukpurok	U	Obeña 7124 (PBDH)	
		unidentified	Balukawi Kawayan	U	Obeña 7142 (PBDH)	

Sensu 1pPG 1 (2016) and 2APG IV (2016).

*Tree (T), Herb (H), Understory (U), or Shrub (S).

Categories. The plants are listed in Table 2, showing their corresponding conservation status at global and national levels, respectively.

***Shorea negrosensis* Foxw.**

Shorea negrosensis is a Philippine endemic tree species in Family Dipterocarpaceae. This species, together with other dipterocarp species, are exploited due to its excellent source of wood for lumber (Ghazoul, 2016), for general construction, veneer, hardboard, cabinet, and furniture making (Garcia et al., 2013). It is categorized as Least Concern (LC) by the IUCN, however, it is listed as Vulnerable (VU) in DENR DAO 2017-11.

***Wallaceodendron celebicum* Koord.**

This species (Fig. 2.D) is categorized as Vulnerable in DENR DAO 2017-11. This species is distributed in the Philippines and Sulawesi. The wood of this tree is used for furniture making in Leyte (Mangaoang and Pasa, 2003).

***Artocarpus rubrovenius* Warb.**

The species (Fig. 2.B) is endemic to the Philippines (Luzon and Mindoro), and is listed as Other Threatened Species (OTS) in DENR DAO 2017-11. This is the first local record of this species from Samar Island. Its softwood is used for woodcarving in Ifugao (Hayama, 2000).

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

Aquilaria cumingiana (Fig. 2.E) is known as a source of agarwood, a highly prized resin with multiple economic uses (Lee and Mohamed, 2016). This species distributed in the Philippines and Indonesia and is listed as Vulnerable (VU) by the IUCN and in DENR DAO 2017-11.

***Gymnostoma rumphianum* (Miq.) L.A.S. Johnson**

The species is widely distributed in the Philippines, Sulawesi, and Moluccas. This Casuarinaceae species commonly grows on

limestone habitat and is used for piles, posts, poles, and rafters. It is also used as a source of fuelwood (Diem and Dommergues, 1990). The plant is categorized as Other Threatened Species (OTS) in DENR DAO 2017-11.

Faunal diversity

A total of 106 terrestrial vertebrates composed of 4 amphibian, 9 reptile, 84 bird, and 9 mammal species were recorded during the fieldwork (Table 3) with 71 (67%) endemic to the Philippines. All four (100%) species of amphibians recorded are endemic to the Philippines, 3 (75%) of which are Mindanao PAIC endemics. Of the 9 reptiles, 4 (44.44%) are endemic to the country, 3 (33.33%) of which are endemic to the greater Mindanao PAIC. Fifty-six (66.67%) of the species of birds are endemic to the Philippines, 20 (23.81%) of which are endemic to the Mindanao PAIC. Of the 9 mammals, 6 (66.67%) are endemic to the country, 4 (44.44%) are endemic to the greater Mindanao faunal region. As there are no other published studies of faunal diversity in Paranas, most of these represent new locality records for the municipality.

All amphibian species recorded in the study site belong to the genus *Platymantis*. These frog species, namely Philippine Wrinkled Ground Frog (*Platymantis corrugatus*), Gunther's Wrinkled Ground Frog (*Platymantis guentheri*), and Rabor's Forest Frog (*Platymantis rabori*) were documented in Paranas with a suspected new locality record of Walter's limestone frog (*Platymantis bayani*; Fig. 3.A) from the site. All forest frogs recorded are highly terrestrial (Brown et al. 1997; Siler et al., 2009). Rabor's horned tree frog (*Platymantis rabori*) and Walter's limestone frog (*Platymantis bayani*) are both listed as Vulnerable in the Updated National List of Threatened Philippine Fauna and Their

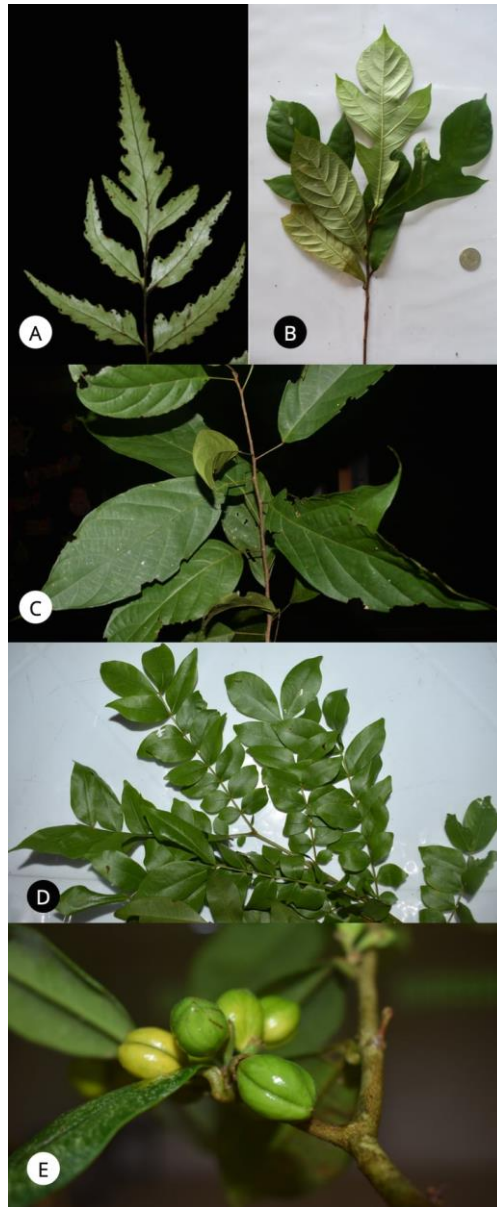


FIGURE 2. Photos showing some of the limestone flora of Paranas, Samar: A) *Tectaria calcarea* (C. Presl) Copel., B) *Artocarpus rubrovenius* Warb., C) *Hancea wenzeliana* (Slik) S.E.C.Sierra, Kulju & Welzen, D) *Wallaceodendron celebicum* Koord., and E) *Aquilaria cumingiana* (Decne.) Ridl.

Categories (DENR-DAO 2019-09; Gonzalez et al., 2018).

The 9 reptilian species recorded from the study site (Table 3) belong to 6 families in

Order Squamata. The families Agamidae, Scincidae, and Colubridae are represented by 2 species each, with the remaining families representing only 1 species each.

TABLE 2. Vascular plants in Paranas, Samar Island with available conservation status from IUCN and/or DENR DAO 2017-11.

FAMILY	SCIENTIFIC NAME	COMMON NAME	DISTRIBUTION	REFERENCES	CONSERVATION STATUS**	
					IUCN 2017	2017-11 DAO
Blechnaceae	<i>Ocniopteris egregia</i> (Copel.)	No recorded common name	Borneo, New Guinea, Solomon Isls, Philippines, Mindanao: Bukidnon, Davao Oriental, Misamis Occidental, North Cotabato, Palawan Native to the Philippines	Pelser et al. (2011-onwards); Copeland EB, 1960	-	VU
Ammonaceae	<i>*Goniolobus cf. lanceifolius</i> Merr.	No recorded common name	Luzon: Albay, Ilocos Norte, Cagayan, Nueva Vizcaya, Nueva Ecija, Rizal, Bataan, Laguna, Quezon, Camarines, Sorsogon, Mindoro, Leyte, Samar, Mindanao: Agusan, Cotabato, Zamboanga	Plants of the World Online	EN	-
Ammonaceae	<i>*Orophea cumingiana</i> S. Vidal	Aminat, Karasikat, Lanudin, Lobanti, Poagan	Luzon: Albay, Ilocos Norte, Cagayan, Nueva Vizcaya, Nueva Ecija, Rizal, Bataan, Laguna, Quezon, Camarines, Sorsogon, Mindoro, Leyte, Samar, Mindanao: Agusan, Cotabato, Zamboanga	Pelser et al. (2011-onwards)	NT	OTS
Myrsicaceae	<i>*Horsfieldia ardisifolia</i> (A.DC.) Warb.	No recorded common name	Luzon, Mindoro, Sibuyan, Leyte, Samar	Pelser et al. (2011-onwards)	VU	VU
	<i>*Horsfieldia samarensis</i> W.J. de Wilde	No recorded common name	Samar: Eastern Samar	Pelser et al. (2011-onwards)	CR	VU
	<i>Knema stellata</i> ssp. <i>stellata</i>	No recorded common name	Samar forests	Pelser et al. (2011-onwards)	VU	VU
Araceae	<i>*Myrsicella pilosigemma</i> W.J. de Wilde	No recorded common name	Samar: Western Samar (Mt. Soloton), Mindanao	Pelser et al. (2011-onwards)	CR	-
	<i>*Alocasia zebrina</i> Schott ex Van Houtte	Handuroy	Luzon: Laguna, Quezon, Bicol, Sorsogon, Leyte, Samar, and Mindanao	Briones and Cuevas 2013; Hay 1999	NE	VU
Arecaceae	<i>*Calamus aidae</i> Fernando	Uli (Biliran), Uli (Samar), Inlian (Agusan del Sur)	Native to the Philippines	Plants of the World Online	NE	NT
	<i>Calamus symphyotipus</i> C. Mart.	Baluaog (Manobo), Palanog	Luzon: Sorsogon, Catanduanes, Bucas Grande, Mindanao: Agusan, SAMAR.	Pelser et al. (2011-onwards)	NE	NT
	<i>*Calamus zollingeri</i> ssp. <i>merrillii</i>	No recorded common name	Basilan, Luzon: Rizal, Laguna, Quezon, Masbate, Mindanao: Agusan, Davao (Mt Apo), Lanao, Mindoro, Palawan, Panay	Pelser et al. (2011-onwards)	-	OTS
	<i>Caryota rumphiana</i> Mart.	Pugahan/ Tagabunga	Philippines to Solomon Island, Samar	Adorador and Fernando 2017	LC	-
	<i>*Heterospathe intermedia</i> (Becc.) Fernando	Banga	Luzon: Sorsogon (Mt Bulusan; Bulusan Lake), Biliran (Naval, Mt Sayao), Leyte (Ormoc, Mt Janagdan; Baybay, Mt Pangasugan; Mt Abucayan), Samar: Catubig River, Mindanao: Agusan del Norte (Mt Urdaneta), Surigao del Norte (Mt Kabatuan)	Pelser et al. (2011-onwards)	VU	-
Marantaceae	<i>*Phrynium minutiflorum</i> Suksathan & Borchs.	Hagikihik (Waray)	Native to the Philippines	Plants of the World Online	NE	VU
Nepentaceae	<i>*Nepenthes samar</i> Jebb & Cheek	No recorded common name	Samar	Pelser et al. (2011-onwards)	-	CE
Clusiaceae	<i>*Garcinia rubra</i> Merr.	Dits	Luzon: Apayao, Cagayan, Isabela, Rizal, Quezon, Laguna, Camarines,	Pelser et al. (2011-onwards)	NT	-

TABLE 2. (Continue)

FAMILY	SCIENTIFIC NAME	COMMON NAME	DISTRIBUTION	REFERENCES	CONSERVATION STATUS**		
					IUCN 2017	DAO 2017-11	
Euphorbiaceae	<i>*Trilaxis ixoroides</i> (C.B.Rob.) R.Y.Yu & Welzen	No common name	Sorsogon, Mindoro, Catanduanes, Leyte, Samar, Camiguin, Mindanao, Basilan, Luzon	Pelser et al. (2011-onwards)	-	-	-
Euphorbiaceae	<i>*Hancea wenzeliana</i> (Slik) S.E.C. Sierra, Kulju & Welzen	Apanang	Mindanao: Surigao del Norte	Pelser et al. (2011-onwards)	CR	-	-
Euphorbiaceae	<i>*Macaranga bicolor</i> Müll.Arg.	Pailig	Luzon: Cagayan, Isabela, Apayao, Nueva Vizcaya, Bulacan, Bataan, Quezon, Laguna, Camarines, Sorsogon, Polillo, Mindoro, Panay, Biliran, Leyte, Samar, Sibuyan, Mindanao	Pelser et al. (2011-onwards); Merrill (1923-1926)	LC	-	-
Fabaceae (Leguminosae)	<i>Wallaciodendron celebicum</i> Koord.	Buniyo/ Salukigi	Luzon: Benguet Province, Baguio, Babuyan Islands, (Camiguin), Cagayan, Isabela, Aurora, Quezon, Camarines, Burias, Masbate, Negros, Cebu, Samar, Indonesia	Pelser et al. (2011-onwards); Merrill (1923-1926)	NE	-	VU
Moraceae	<i>*Artocarpus ribrovenitus</i> Warb.	Tugop	Bataan, Luzon: Isabela, Aurora, Bataan, Pampanga, Rizal, Laguna, Batangas, Quezon, Camarines, Albay, Sorsogon, Mindoro	Pelser et al. (2011-onwards)	VU	-	OTS
	<i>Ficus ampelas</i> Burm.f.	Lanete	Batanes, Luzon: Abra, Ifugao, Benguet, Cagayan, Isabela, Nueva Ecija, Zambales, Rizal, Laguna, Camarines, Albay, Palawan, Sibuyan, Panay, Leyte, Samar, Camiguin De Mindanao, Mindanao; Davao del Sur, Agusan, Japan (Ryukyu Isls), Taiwan, Malaysia, Indonesia, Papua New Guinea	Pelser et al. (2011-onwards); Merrill (1923-1926)	LC	-	-
Urticaceae	<i>Oreocnide ribescens</i> (Blume) Miq.	Lingatong	Luzon: Laguna, Quezon to Mindanao, Indonesia	Pelser et al. (2011-onwards); Merrill (1923-1926)	LC	-	-
Casuarinaceae	<i>Gymnostoma runghianum</i> (Miq.) L.A.S. Johnson	Agoho	Philippines (N. Luzon to Palawan and Mindanao), Indonesia, Papua New Guinea	Diem and Dommergues 1990	NE	-	OTS
Meliaceae	<i>Aglaia rimosa</i> (Blanco) Merr.	No recorded common name	Philippines: Y.AMI, Bataan, Babuyan Isls., Luzon: Ilocos Norte, Benguet, Pangasinan, Cagayan, Isabela, Nueva Vizcaya, Aurora, Nueva Ecija, Bataan, Rizal, Laguna, Quezon, Cavite, Batangas, Camarines, Albay, Sorsogon, Alabat, Mindoro, Palawan, Romblon, Sibuya, Ticao, Panay, Guimaras, Negros, Sibutu, Mindanao (Davao, Agusan), Taiwan, Indonesia, Papua New Guinea	Pelser et al. (2011-onwards); Merrill (1923-1926)	NT	-	-
Burseraceae	<i>Canarium hirsutum</i> Willd.	Milipili	Throughout the Philippines and Malesia except New Guinea and New Britain (Palau)	Pelser et al. (2011-onwards)	LC	-	-

TABLE 2. (Continue)

FAMILY	SCIENTIFIC NAME	COMMON NAME	DISTRIBUTION	REFERENCES	CONSERVATION STATUS**		
					IUCN	2017	2017-11
							DAO
Thymelaeaceae	<i>Aquilaria cumingiana</i> (Decne.) Ridl.	Lapisan/ Agar	Philippines: Luzon Laguna, Catanduanes, Malaysia, Indonesia	Lee and Mohamed 2016	VU	VU	VU
Dipterocarpaceae	<i>*Hopea philippinensis</i> Dyer	Gisok	Luzon: Laguna, Quezon, Camarines, Albay, Samar, Biliran, Leyte, Panay, Negros, Samar, Mindanao: Zamboanga, Lanao, Agusan Samar	Pelser et al. (2011-onwards)	EN	EN	CE
Dipterocarpaceae	<i>*Hopea quisumbingiana</i> Gutierrez	Quisumbing-Gisok		Pelser et al. (2011-onwards)	EN	EN	CE
Dipterocarpaceae	<i>*Hopea samarensis</i> Gutierrez	Samar Gisok	Samar	Pelser et al. (2011-onwards)	EN	EN	CE
Dipterocarpaceae	<i>*Shorea negrosensis</i> Foxw.	Lawaan na Pula (Takuban)	Luzon: Cagayan, Isabela, Aurora, Nueva Ecija, Laguna, Quezon, Camarines, Albay, Sorsogon, Polillo, Negros, Cebu, Leyte, Biliran, Samar, Mindanao: Zamboanga, Lanao, Cotabato, Bukidnon, Davao, Surigao, Agusan, Basilan	Pelser et al. (2011-onwards); Merrill (1923-1926)	LC	LC	VU
Anacardiaceae	<i>Mangifera monandra</i> Merr.	No recorded common name	Luzon: Ilocos Norte, Pangasinan, Zambales, Bataan, Rizal, Laguna, Camarines, Ticao, Guimaras, Leyte, Samar	Pelser et al. (2011-onwards)	NT	NT	E
Sapindaceae	<i>*Gloeocarpus patentivalvis</i> (Radlk.) Radlk. in Engl.	No recorded common name	Luzon, Leyte, Samar, Mindanao	Pelser et al. (2011-onwards)	EN	EN	E
Apocynaceae	<i>*Guttoa discolor</i> Radlk.	No recorded common name	Luzon: Isabela, Aurora, Samar	Pelser et al. (2011-onwards)	EN	EN	VU
Lamiaceae	<i>*Kibatalia merrilliana</i> Woodson	No recorded common name	Leyte, Samar	Pelser et al. (2011-onwards)	EN	EN	VU
	<i>*Kibatalia puberula</i> Merr.	No recorded common name	Samar	Pelser et al. (2011-onwards)	EN	EN	E
	<i>Vitex turezantinowii</i> Merr.	Kolipapa	Batanes, Luzon: Ilocos Sur, Pangasinan, Cagayan, Isabela, Bataan, Rizal, Laguna, Quezon, Sorsogon, Mindoro, Ticao, Leyte, Mindanao: Agusan, Surigao, Malaysia, Indonesia	Pelser et al. (2011-onwards)	LC	LC	-
Araliaceae	<i>Polyscias nodosa</i> (Blume) Seem.	Bongliw	Luzon: Benguet, Pangasinan, Zambales, Bataan, Rizal, Quezon, Laguna, Batangas, Sorsogon, Palawan, Leyte, Basilan, Mindanao, Australia, Indonesia, Solomon Islands	Philippson 1979; Merrill (1923-1926)	LC	LC	-
Simonuraceae	<i>Gomphandra mappitoides</i> Valetton	No recorded common name	Lesser Sunda Isls, Sulawesi, Moluccas, Philippines, Luzon: Sorsogon, Negros, Bohol, Leyte, Samar, Mindanao: Davao	Pelser et al. (2011-onwards)	LC	LC	-

*Philippine endemic

**Conservation Status: VU – Vulnerable, EN – Endangered, NT – Near Threatened, OTS – Other Threatened Species, LC – Least Concern

TABLE 3. Terrestrial vertebrate fauna recorded from the forest over limestone study sites in Paranas, Samar.

ORDER	FAMILY	SPECIES	COMMON NAME	DISTRIBUTION	CONSERVATION STATUS*		REFERENCES
					IUCN	DAO 2019-09	
Amphibians							
Anura	Ceratobatrachidae	<i>Platymantis corrugatus</i> Duméril, 1853	Philippine Wrinkled Ground Frog	Philippine endemic	LC	None	Fieldwork
		<i>Platymantis guentheri</i> Boulenger, 1882	Günther's Wrinkled Ground Frog	Mindanao PAIC endemic	LC	None	Fieldwork
		<i>Platymantis raboti</i> Brown, Alcala, Diesmos, and Alcala, 1997	Rabor's Forest Frog	Mindanao PAIC endemic	LC	VU	Fieldwork
		<i>Platymantis boyani</i> Siler, Alcala, Diesmos, and Brown, 2009	Walter's Limestone Frog	Mindanao PAIC endemic	DD	VU	Fieldwork; Siler et al. 2009
Reptiles							
Squamata	Agamidae	<i>Draco ornatus</i> Gray, 1845	White Spotted Flying Lizard	Mindanao PAIC endemic	LC	None	Fieldwork; McGuire & Alcala 2000
		<i>Draco reticulatus</i> Günther, 1864	Günther's flying lizard	Philippine endemic	LC	None	Fieldwork; McGuire & Alcala 2000
	Scincidae	<i>Eutropis multifasciata</i> Kuhl, 1820	Common Mabuya	Resident	LC	None	Fieldwork
		<i>Eutropis multicarinata</i> Gray, 1845	Two-striped Mabouya	Resident	DD	None	Fieldwork
	Gekkonidae	<i>Cyrtodactylus sumuroi</i> Welton, Siler, Linkem, Diesmos & Brown, 2010	None	Mindanao PAIC endemic; Samar Island	NA	None	Siler et al. 2010; Welton et al. 2010a,b
		<i>Lycodon dumerilii</i> Boulenger, 1893	Duméril's Asian Wolf Snake	Mindanao PAIC endemic	LC	None	Fieldwork
	Colubridae	<i>Segonotus muelleri</i> Duméril, Bibron & Duméril, 1854	Muller's ratsnake	Mindanao PAIC endemic	NT	None	Fieldwork
		<i>Psammodynastes pulverulentus</i> Boie, 1827	Philippine Mock Viper	Resident	NA	None	Fieldwork
	Pareidae	<i>Aplopeltura boa</i> Boie, 1828	Blunthead Slug Snake	Resident	LC	None	Fieldwork
	Birds						
Accipitriformes	Accipitridae	<i>Nisaetus pinskeri</i> Preleuthner & Gamauf, 1998	Pinsker's Hawk-Eagle	Philippine endemic	EN	EN	Kearns, M. 2016d
		<i>Pernis ptilorhynchus</i> Temminck, 1821	Oriental Honey-buzzard	Resident	LC	None	Dy, I. 2016d
		<i>Spilornis holospilus</i> Vigors, 1831	Philippine Serpent-Eagle	Philippine endemic	LC	None	Dy, I. 2016b
Bucerotiformes	Bucerotidae	<i>Buceros hydrocorax semigaleatus</i> Tweeddale, 1878	Southern Rufous Hornbill	Mindanao PAIC endemic	VU	EN	Fieldwork
		<i>Penelopides affinis samarensis</i> Steere, 1890	Samar hornbill	Mindanao PAIC endemic	LC	EN	Fieldwork

TABLE 3. (Continue)

ORDER	FAMILY	SPECIES	COMMON NAME	DISTRIBUTION	CONSERVATION STATUS*		REFERENCES
					IUCN	DAO 2019-09	
Caprimulgiformes	Apodidae	<i>Collocalia esculenta</i> ssp. <i>marghinata</i> Salvadori, 1882	Philippine glossy swiftlet	Resident	LC	None	Fieldwork
		<i>Collocalia troglodytes</i> Gray, 1845	Pygmy Swiftlet	Philippine endemic	LC	None	Rathgeber, M. 2017
	Caprimulgidae	<i>Lyncornis macrotis</i> Vigors, 1831	Great Eared-Nighthjar	Resident	LC	None	Cooleman, S. 2016b
		<i>Caprimulgus manillensis</i> Walden, 1875	Philippine Nighthjar	Philippine endemic	LC	None	Cooleman, S. 2016b
Cuculiformes	Podargidae	<i>Batrachostomus septimus</i> Tweeddale, 1877	Philippine Frogmouth	Philippine endemic	LC	None	Kearns, M. 2016b
		<i>Eudynamis scolopacea mindanensis</i> Linnaeus, 1766	Common Koel	Resident	LC	None	Fieldwork
	Cuculidae	<i>Centropus melanops</i> Lesson, 1830	Black-faced Coucal	Mindanao PAIC endemic	LC	None	Francisco, R. 2012
		<i>Centropus viridis</i> Scopoli, 1786	Philippine Coucal	Philippine endemic	LC	None	Kearns, M. 2016c
Columbiformes	Columbidae	<i>Surniculus velutinus</i> Sharpe, 1877	Philippine Drongo-Cuckoo	Philippine endemic	LC	None	Cooleman, S. 2016d
		<i>Cacomantis variolosus</i> Vigors & Horsfield, 1826	Brush Cuckoo	Resident	LC	None	Dy, I. 2016c
		<i>Phapitreron brevirostris</i> Tweeddale, 1877	Short-billed brown dove	Mindanao PAIC endemic	LC	None	Fieldwork
		<i>Chalcophaps indica</i> Linnaeus, 1758	Common Emerald dove	Resident	LC	None	Fieldwork
Coraciiformes	Alcedinidae	<i>Macropygia tenuirostris</i> Bonaparte, 1854	Philippine Cuckoo-Dove	Resident	LC	None	Cooleman, S. 2016b
		<i>Ptilinopus occipitalis</i> Gray, 1844	Yellow-breasted Fruit-Dove	Philippine endemic	LC	None	Kearns, M. 2016c
		<i>Galliolumba crinigera</i> Pucheran, 1853	Mindanao Bleeding-heart	Mindanao PAIC endemic	VU	VU	Kearns, M. 2016d
		<i>Ceyx melanurus</i> Kaup, 1848	Philippine Dwarf-Kingfisher	Philippine endemic	VU	VU	Taylor, J. 2013b
Coraciidae	Coraciidae	<i>Todiramphus winchelli</i> Sharpe, 1877	Rufous-lored Kingfisher	Philippine endemic	VU	VU	Kearns, M. 2016d
		<i>Halcyon gularis</i> Kuhl, 1820	Brown-breasted Kingfisher	Resident	LC	None	Barcenas, B.T. 2018
		<i>Eurystomus orientalis</i> Linnaeus, 1766	Dollarbird	Resident	LC	None	Taylor, J. 2013c
		<i>Merops philippinus</i> Linnaeus, 1766	Blue-tailed Bee-eater	Resident	LC	None	Hutchinson, R. 2015a
Galliformes	Megapodiidae	<i>Merops americanus</i> P. L. S. Müller, 1776	Rufous-crowned Bee-eater	Philippine endemic	LC	None	Taylor, J. 2013c
		<i>Megapodius cumingii</i> Dillwyn, 1853	Tabon Scrubfowl	Resident	LC	VU	Cooleman, S. 2016a
		<i>Gallus gallus</i> Linnaeus, 1758	Red Junglefowl	Resident	LC	None	Taylor, J. 2014b
		<i>Pericrocotus speciosus</i> Forster, 1781	Scarlet Minivet	Resident	LC	None	Cooleman, S. 2016a

TABLE 3. (Continue)

ORDER	FAMILY	SPECIES	COMMON NAME	DISTRIBUTION	CONSERVATION STATUS*		REFERENCES
					IUCN	DAO 2019-09	
Cisticolidae		<i>Orthotomus frontalis</i> Sharpe, 1877	Rufous-fronted Tailorbird	Mindanao PAIC endemic	LC	None	Hutchinson, R. 2015b
		<i>Micromacronus leytenensis</i> Amadon, 1962	Visayan Miniature tit-babbler	Mindanao PAIC endemic	DD	VU	Francisco, R. 2012
		<i>Orthotomus samarensis</i> Steere, 1890	Yellow-breasted Tailorbird	Mindanao PAIC endemic	NT	OTS	Taylor, J. 2013b
Dicaeidae		<i>Dicaeum pygmaeum</i> Kittlitz, 1833	Pygmy Flowerpecker	Philippine endemic	LC	None	Hutchinson, R. 2015a
		<i>Prionochilus olivaceus</i> Tweeddale, 1877	Olive-backed Flowerpecker	Philippine endemic	LC	None	Taylor, J. 2013b
		<i>Dicaeum hypoleucum</i> Sharpe, 1876	White-bellied Flowerpecker	Philippine endemic	LC	None	Hutchinson, R. 2015b
		<i>Dicaeum trigonostigma</i> Scopoli, 1786	Orange-bellied Flowerpecker	Resident	LC	None	Barcenas, B.T. 2018
		<i>Dicaeum austral</i> Hermann, 1783	Red-keeled Flowerpecker	Philippine endemic	LC	None	Dy, I. 2016a
		<i>Dicaeum bicolor</i> Bourns & Worcester, 1894	Bicolored Flowerpecker	Philippine endemic	LC	None	Dy, I. 2016c
		<i>Dicrurus striatus samarensis</i> Tweeddale, 1877	Short-tailed Drongo	Mindanao PAIC endemic	LC	None	Kearns, M. 2016c
		<i>Eurylaimus samarensis</i> Steere, 1890	Visayan Broadbill	Mindanao PAIC endemic	VU	VU	Kearns, M. 2016c
		<i>Hirundo rustica</i> Linnaeus, 1758	Barn Swallow	Resident	LC	None	Arce, K. 2015
		<i>Irena cyanogastra</i> Vigors, 1831	Philippine Fairy-bluebird	Philippine endemic	NT	None	Barcenas, B.T. 2018
Laniidae		<i>Lanius cristatus</i> Linnaeus, 1758	Brown Shrike	Resident	LC	None	Taylor, J. 2013a
		<i>Megalururus palustris</i> Horsfield, 1821	Striated Grassbird	Resident	LC	None	Rathgeber, M. 2017
Locustellidae		<i>Terpsiphone cinnamomea</i> Sharpe, 1877	Rufous Paradise-Flycatcher	Resident	LC	None	Barcenas, B.T. 201
		<i>Hypothymis azurea</i> Boddaert, 1783	Black-naped Monarch	Resident	LC	None	Dy, I. 2016c
Motacillidae		<i>Hypothymis coelestis</i> Tweeddale, 1877	Celestial Monarch	Philippine endemic	VU	CR	Arce, K. 2015
		<i>Motacilla cinerea</i> Tunstall, 1771	Gray Wagtail	Resident	LC	None	Hutchinson, R. 2015a
Muscicapidae		<i>Ficedula basihanica</i> Sharpe, 1877	Little Slaty Flycatcher	Mindanao PAIC endemic	VU	VU	Dy, I. 2016c
		<i>Cyornis ruficauda</i> Sharpe, 1877	Rufous-tailed jungle-flycatcher	Resident	LC	None	Arce, K. 2015
Nectariniidae		<i>Leptocoma sperata</i> Linnaeus, 1766	Purple-throated Sunbird	Resident	LC	None	Rathgeber, M. 2017
		<i>Cinnyris jugularis</i> Linnaeus, 1766	Olive-backed Sunbird	Resident	LC	None	Dy, I. 2016d

TABLE 3. (Continue)

ORDER	FAMILY	SPECIES	COMMON NAME	DISTRIBUTION	CONSERVATION STATUS*		REFERENCES
					IUCN	DAO 2019-09	
Oriolidae	Pachycephalidae	<i>Aethopyga pulcherrima</i> Sharpe, 1876	Metallic-winged Sunbird	Mindanao PAIC endemic	LC	None	Kearns, M. 2016c
		<i>Aethopyga bella</i> Tweeddale, 1877	Handsome Sunbird	Philippine endemic	LC	None	Hutchinson, R. 2015b
		<i>Arachnothera clarae</i> Blasius, 1890	Naked-faced Spiderhunter	Philippine endemic	LC	None	Hutchinson, R. 2015b
		<i>Antheptes griseigularis</i> Tweeddale, 1878	Gray-throated Sunbird	Philippine endemic	LC	OTS	Taylor, J. 2014a
		<i>Oriolus steerii</i> Sharpe, 1877	Philippine Oriole	Philippine endemic	LC	None	Cooleman, S. 2016c
		<i>Pachycephala philippinensis</i> Walkden, 1872	Yellow-bellied Whistler	Philippine endemic	LC	None	Yellow-bellied Whistler
		<i>Pardaliparus elegans</i> Lesson, 1831	Elegant Tit	Philippine endemic	LC	None	Kearns, M. 2016c
		<i>Passer montanus</i> Linnaeus, 1758	Eurasian Tree Sparrow	Resident	LC	None	Rathgeber, M. 2017
		<i>Philoctichla mindanensis</i> Bourns & Worcester, 1894	Striated Wren-babbler	Mindanao PAIC endemic	LC	None	Fieldwork
		<i>Phylloscopus olivaceus</i> Moseley, 1891	Philippine Leaf Warbler	Philippine endemic	LC	None	Kearns, M. 2016c
Pittidae	Pycnonotidae	<i>Phylloscopus borealis</i> Blasius, 1858	Arctic Warbler	Resident	LC	None	Taylor, J. 2013b
		<i>Pitta steerii</i> ssp. <i>coelestis</i> Parkes, 1971	Steere's pitta	Mindanao PAIC endemic	VU	VU	Fieldwork
		<i>Hypsipetes philippinus saturator</i> E. J. O. Hartert, 1916	Philippine bulbul	Philippine endemic	LC	None	Fieldwork
		<i>Pycnonotus urostictus atricaudatus</i> Parkes, 1967	Yellow wattled bulbul	Philippine endemic	LC	None	Fieldwork
		<i>Hypsipetes everetti</i> Tweeddale, 1877	Yellowish Bulbul	Mindanao PAIC endemic	LC	None	Barcenas, B.T. 2018
		<i>Pycnonotus goiavier</i> Scopoli, 1786	Yellow-vented Bulbul	Resident	LC	None	Dy, I. 2016c
		<i>Rhipidura nigritorquis</i> Vigors, 1831	Philippine Pied Fantail	Philippine endemic	LC	None	Fieldwork
		<i>Rhipidura samarensis</i> Steere, 1890	Visayan Blue-Fantail	Mindanao PAIC endemic	LC	None	Rathgeber, M. 2017
		<i>Sitta oenochlamys</i> Sharpe, 1877	Sulphur-billed Nuthatch	Philippine endemic	LC	None	Cooleman, S. 2016a
		<i>Sarcops calvus</i> Linnaeus, 1766	Coledo	Philippine endemic	LC	None	Dy, I. 2016c
Timaliidae	Timaliidae	<i>Rhabdornis mystacalis</i> Temminck, 1825	Stripe-headed rhabdornis	Philippine endemic	LC	None	Cooleman, S. 2016a
		<i>Macronus striaticeps</i> Sharpe, 1877	Brown Tit-Babbler	Mindanao PAIC endemic	LC	None	Barcenas, B.T. 2018

TABLE 3. (Continue)

ORDER	FAMILY	SPECIES	COMMON NAME	DISTRIBUTION	CONSERVATION STATUS*		REFERENCES
					IUCN	DAO 2019-09	
Piciformes	Zosteropidae	<i>Zosterops everetti</i> Tweeddale, 1878	Everett's White-eye	Resident	LC	None	Rathgeber, M. 2017
		<i>Sterrhophilus nigrocapitatus</i> Steere, 1890	Black-crowned Babbler	Philippine endemic	LC	None	Kearns, M. 2016c
		<i>Dasyroptapha pygmaea</i> Ogilvie-Grant, 1896	Visayan Pygmy-Babbler	Mindanao PAIC endemic	NT	OTS	Kearns, M. 2016c
	Megalaimidae	<i>Psilopogon haemacephalus celestinoi</i> Gilliard, 1949	Coppersmith barbet	Resident	LC	None	Fieldwork
	Picidae	<i>Yungipicus maculatus</i> Scopoli, 1786	Philippine Pygmy Woodpecker	Philippine endemic	LC	None	Hutchinson, R. 2015b
		<i>Chrysocolaptes lucidus</i> Scopoli, 1786	Buff-spotted Flameback	Mindanao PAIC endemic	LC	None	Francisco, R. 2012
	Psittaculidae	<i>Loriculus philippensis</i> Müller, 1776	Philippine Hanging-Parrot	Philippine endemic	LC	CR	Rathgeber, M. 2017
	Strigidae	<i>Otus everetti</i> Tweeddale, 1897	Everett's Scops-Owl	Mindanao PAIC endemic	LC	None	Dy, I. 2016d
		<i>Ninox philippensis</i> Bonaparte, 1855	Philippine hawk-owl	Philippine endemic	LC	None	Kearns, M. 2016a
	Trogonidae	<i>Harpactes ardens</i> Temminck, 1826	Philippine Trogon	Philippine endemic	LC	None	Rathgeber, M. 2017
Mammals							
Chiroptera	Pteropodidae	<i>Ptenochirus minor</i> Yoshiyuki, 1979	Lesser Musky Fruit Bat	Mindanao PAIC endemic	LC	None	Fieldwork
		<i>Ptenochirus jagori</i> Peters, 1861	Greater Musky Fruit Bat	Philippine endemic	LC	None	Fieldwork
		<i>Cynopterus brachyotis</i> Müller, 1838	Lesser Dog-faced Fruit Bat	Resident	LC	None	Fieldwork
Primates	Tarsiidae	<i>Macroglauus minimus</i> E. Geoffroy, 1810	Dagger-toothed Long-nosed Fruit Bat	Resident	LC	None	Fieldwork
		<i>Tarsius syrichta</i> Linnaeus, 1758	Philippine Tarsier	Mindanao PAIC endemic	NT	OTS	Fieldwork
Rodentia	Muridae	<i>Rattus everetti</i> Günther, 1879	Philippine forest rat	Philippine endemic	LC	None	Fieldwork
		<i>Bullimus bagobus</i> Mearns, 1905	Bagobo rat	Mindanao PAIC endemic	LC	None	Fieldwork
		<i>Rattus tanezumi</i> Temminck, 1844	Oriental house rat/ Asian house rat	Resident	LC	None	Fieldwork
Dermoptera	Cynocephalidae	<i>Cynocephalus volans</i> Linnaeus, 1758	Philippine flying lemur	Mindanao PAIC endemic	LC	None	Ethnobiological data

*EN – Endemic, VU – Vulnerable, NT – Near Threatened, OTS – Other Threatened Species, LC – Least Concern, DD – Data Deficient, NA – Not Assessed.

The snakes were represented by 3 families, namely Colubridae, Lamprophiidae, and Pareidae. Most of the species are listed as least concern in the IUCN Red List, but a large percentage has not yet been evaluated, implying that further research is urgently needed to be able to conserve and protect these valuable animals and the habitat.

The 84 bird species recorded in the study site belong to 43 families under 12 orders. The Order Passeriformes is best represented, with 49 species belonging to 26 families. Some of the avian species observed during the fieldwork categorized as Vulnerable in the IUCN red list include the Southern Rufous Hornbill (*Buceros mindanensis* ssp. *semigaleatus*; Fig. 3.C) and Steere's Pitta (*Pitta steerii* ssp. *coelestis*). Moreover, Amethyst Brown-dove (*Phapitreron amethystinus*) and Samar hornbill (*Penelopides affinis* ssp. *samarensis*) which were also observed during the fieldwork are listed as Critically Endangered and Endangered in the DENR-DAO 2019-09, respectively.

A total of 4 volant mammal species belonging to family Pteropodidae under order Chiroptera were recorded in the study site. All species are listed in the IUCN Red List as Least Concern. Also, 5 non-volant mammal species belonging to 3 families under 3 orders were recorded. The Philippine tarsier (*Tarsius syrichta*) is considered Near Threatened in the IUCN Red List and categorized as Other Threatened Species in the DENR-DAO 2019-09. The most represented order for non-volant mammals was Rodentia with 3 species belonging to belonging to Family Muridae, but this includes the Oriental house rat (*Rattus tanezumi*), an introduced species that is considered an agricultural pest and poses a threat to other animals that are native in the forests over limestone.

Notable animal species

***Platymantis bayani* Siler, Alcala, Diesmos, and Brown 2009**

Walter's limestone frog (Fig. 3.A) is a species of forest frog that is highly associated with limestone karst habitats. It is known only from Taft on the eastern side of Samar (Siler et al., 2009), and this study presents a new locality record for the species in Paranas on the western part of the island. An adult individual was hand-captured in Brgy. Tenani on a rocky outcrop at 314 meters above sea level (masl), higher than its previous known upper elevation limit of 140 masl (Siler et al., 2009). Very little is known about this species which is why it is categorized as Data Deficient in the IUCN Red List and Vulnerable under the DENR DAO 2019-09.

Buceros mindanensis semigaleatus

Tweeddale, 1878

The southern rufous hornbill (Fig. 3.B) is endemic to the Mindanao PAIC, specifically Samar, Calicoan, Buad, Biliran, Leyte, Bohol, and Panaon (del Hoyo et al., 2020). An assemblage of 5 adults and 1 juvenile was photographed resting on a yakal tree in Brgy. Tenani. It is categorized as Vulnerable in the IUCN Red List and Endangered under the DENR DAO 2019-09 as *Buceros hydrocorax* ssp. *semigaleatus*.

***Draco ornatus* Gray, 1845**

The white-spotted flying lizard (Fig. 3.C) is endemic to the Mindanao PAIC, specifically the islands of Bohol, Dinagat, Leyte, Mindanao, and Samar. An adult individual was hand-captured on the trunk of a coconut tree in Brgy. San Isidro on the same tree as an adult *Draco reticulatus*. The species is known to inhabit coconut plantations as well as primary and secondary forests (McGuire and Alcala, 2000). It is categorized as Least Concern in the IUCN Red List.



FIGURE 3. Photos of some notable forest over limestone fauna of Paranas, Samar: A) *Platymantis bayani* B) *Buceros mindanensis semigaleatus*, C) *Draco ornatus*, and D) *Cynocephalus volans*. Photographs by P.J.S. Tolentino (A, B, C) and J.T. Adorador (D).

***Cynocephalus volans* Linnaeus, 1758**

The Philippine flying lemur (Fig. 3.D) is endemic to the Mindanao PAIC, specifically Mindanao, Basilan, Biliran, Dinagat, Leyte, Siargao, Bohol, Samar (Heaney et al., 1998) and Mariripi (Rickart et al., 1993). An individual was sighted during separate fieldwork conducted by Mr. Jiro T. Adorador in Brgy. Tenani. It is currently categorized as Least Concern in the IUCN Red List, although Heaney et al. (1998) proposed it as Vulnerable due to widespread destruction of their habitat. The latest assessment by the Philippine Red List Committee has delisted the species from the DAO 2019-09 due to its stable population

and wide distribution (Gonzalez et al., 2018), but it is nonetheless important as one of the primary prey items of the Philippine eagle (Ibañez, 2007).

***Tarsius syrichta* Linnaeus, 1758**

The Philippine tarsier is endemic to the Mindanao PAIC, specifically Bohol, Dinagat, Leyte, Mindanao, Samar (Heaney et al. 1998), Basilan (Lawrence, 1939), Biliran and Mariripi (Rickart et al., 1993). An individual was sighted in Brgy. San Isidro during the evening. It is categorized as Near Threatened in the IUCN Red List and Other Threatened Species under the DENR DAO 2019-09.

CONCLUSIONS AND RECOMMENDATIONS

This study revealed the diversity and uniqueness of forests over limestone ecosystem biodiversity in Paranas, Samar Island. Threatened species and their uses were also noted in this checklist to highlight the need for the conservation of these species. Thus, it is essential to mainstream this information to the localities in Paranas and SINP through Communication, Education, and Public Awareness (CEPA). Since there are many unidentified plant species, due to the lack of reproductive parts collected from Paranas, it is recommended to secure high-quality photographs of these plants in future studies. These diagnostic and scientific quality photographs in turn will be deposited in public databases to allow information sharing among botanical experts as well as employ citizen science in possibly identifying these unknown species. The current ecotourism initiatives in Paranas can also serve as an avenue in promoting this information to the public. Furthermore, more than gaining international support for conservation and protection, the inclusion of SINP in the UNESCO World Heritage List can also highlight the biodiversity and aesthetic values of the Philippine karst landscapes on a global stage. Thus, future studies on karst biodiversity, especially in the other administrative municipalities within SINP, are recommended.

To further support and strengthen its nomination for the UNESCO World Natural Heritage Site, further monitoring and biodiversity assessments should be conducted. Additionally, assessments should be conducted on the physical attributes (geology and landforms) of Samar's karst landscapes and ecosystem services provided by the forests over limestone.

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