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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 Urich, 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 Phayayen-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 Urich, 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 eco-systems 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

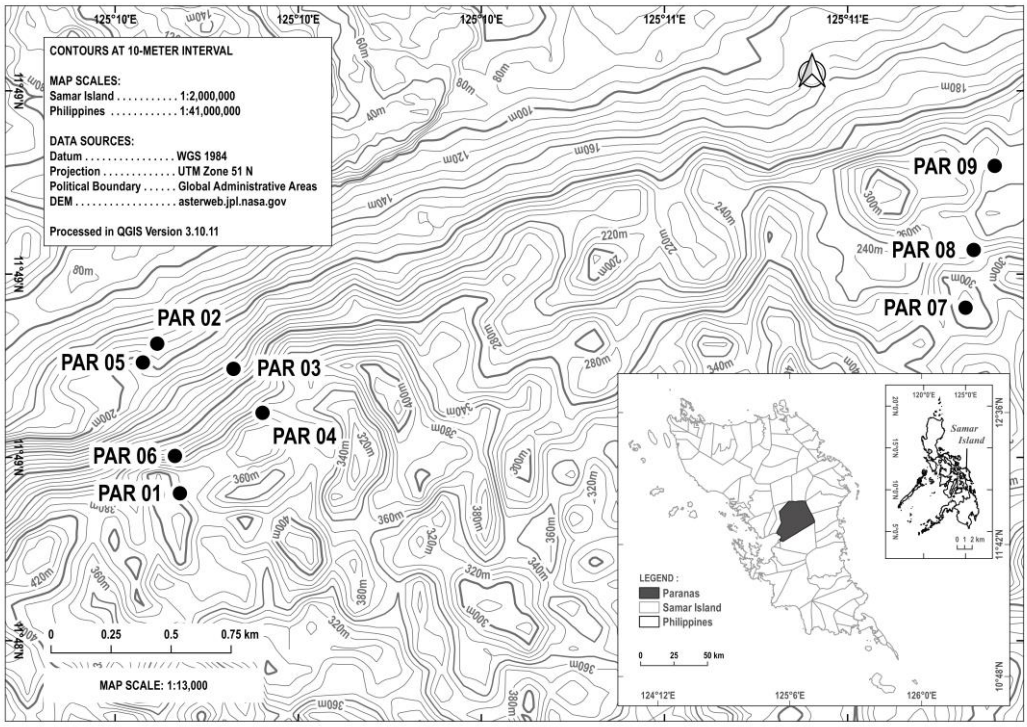

FIGURE 1. Map of sampling plots in Paranas, Samar Island Natural Park (SINP), Philippines. Established plots are marked with black circles.

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 endemicity 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	*Selaginella* sp.	No recorded common name	H	Obeña 7136 (PBDH)	
	Marattiaceae	*Angiopteris* sp.	Palko	T	Obeña 7152 (PBDH)	
	Pteridaceae	*Pteris ensiformis* Burm.	No recorded common name	H	Obeña 7042 (PBDH)	
	Blechnaceae	*Oceaniopteris egregia* (Copel.)	No recorded common name	H	Obeña 7051, Obeña 7058 (PBDH)	
	Thelypteridaceae	*Pronephrium rhombeum* (Christ) Holttum	No recorded common name	H	Obeña 7053 (PBDH)	
	Dryopteridaceae	*Polystichum moluccense* T. Moore	No recorded common name	H	Obeña 7134 (PBDH)	
	Lomariopsidaceae	*Cyclopeltis crenata* (Fée) C. Chr.	Lukdo/ Blue green fern	H	Obeña 7111 (PBDH)	
	Tectariaceae	*Tectaria athyriosora* M.G. Price	No recorded common name	H	Obeña 7048 (PBDH)	
		Tectaria calcarea (C. Presl) Copel.	No recorded common name	H	Obeña 7046, Obeña 7057 (PBDH)	
		Tectaria dissecta (G. Forst.) Lellinger	Nito	H	Obeña 7126 (PBDH)	
		Tectaria psomiocarpa S.Y. Dong	No recorded common name	H	Obeña 7050 (PBDH)	
	Polypodiaceae	*Leptochilus macrophyllus* (Blume)	No recorded common name	H	Obeña 7054 (PBDH)	
Spermatophyta: Angiospermae[2]						
	Lauraceae	*Nothaphoebe leytensis* (Elmer) Merr.	Wakatan	T	Obeña 7149 (PBDH)	
	Annonaceae	*Goniothalamus cf. lancifolius* Merr.	No recorded common name	T		Pelser et al. (2011- onwards)
		Orophea cumingiana S. Vidal	Amúnat, Karasákat, Lanután, Lobanti, Poagan	S		Pelser et al. (2011- onwards)
	Myristicaceae	*Horsfieldia ardisiifolia* (A.DC.) Warb.	No recorded common name	T		Samar Island Natural Park Development Plan, 2007
		Horsfieldia samarensis W.J.de Wilde	No recorded common name	T		Samar Island Natural Park Development Plan, 2007
		Knema stellata ssp. stellata	No recorded common name	T		Samar Island Natural Park Development Plan, 2007
		Myristica pilosigemma W.J.de Wilde	No recorded common name	T		Samar Island Natural Park Development Plan, 2007
	Aristolochaceae	*Thottea tomentosa* (Blume) Ding Hou	No recorded common name	T		Pelser et al. (2011- onwards)
	Piperaceae	*Piper* sp.	Wenter	S	Obeña 7137 (PBDH)	
	Araceae	*Alocasia* sp.	Alocasia sp.	H	Obeña 7100 (PBDH)	
		Alocasia zebrina Schott ex Van Houtte	Handuroy	H	Obeña 7118 (PBDH)	
		Homalomena philippinensis Engl.	Payaw	H	Obeña 7130 (PBDH)	
		Schismatoglottis calyprata (Roxb.) Zoll. & Moritzi	No recorded common name	S	Obeña 7140 (PBDH)	
	Pandanaceae	unidentified	Bariw	T/ S		
	Arecaceae	*Calamus aidae* Fernando	Ulisi (Biliran), Ulasi (Samar), Inhian (Agusan del Sur)	T		Pelser et al. (2011- onwards)
		Calamus discolor C. Mart.	Hamlis, Kumaboy (Tagalog), Ubanon (Cebu, Bisaya)	T		Pelser et al. (2011- onwards)
		Calamus ochrolepis (Becc.) W.J. Baker	No recorded common name	T		Pelser et al. (2011- onwards)

TABLE 1. (Continue)

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

TABLE 1. (Continue)

PLANT GROUP	FAMILY	SCIENTIFIC NAME	COMMON NAME	HABIT*	SOURCES	
					EXSICCATA	REFERENCES
	Sapindaceae	*Gloeocarpus patentivalvis* (Radlk.) Radlk. in Engl.	No recorded common name	T		Samar Island Natural Park Development Plan, 2007
		Guioa discolor Radlk.	No recorded common name	T		Samar Island Natural Park Development Plan, 2007
	Cornaceae	*Mastixia* sp.	Tul-anan	T	Obeña 7148 (PBDH)	
	Sapotaceae	*Palaquium* cf. *elongatum*	No recorded common name	T		
		Palaquium sp. (1)	Bagotambis	T	Obeña 7105 (PBDH)	
		Manilkara fasciculata (Warb.) H.J.Lam & Maas Geest.	Patsaragon	T	Obeña 7129 (PBDH)	
	Apocynaceae	*Kibatalia merrilliana* Woodson	No recorded common name	T		Samar Island Natural Park Development Plan, 2007
		Kibatalia puberula Merr.	No recorded common name	T		Samar Island Natural Park Development Plan, 2007
	Ebenaceae	*Diospyros* sp.	Hambabalud	T	Obeña 7045 (PBDH)	
	Rubiaceae	*Neonauclea* sp.	Kamagong/ Bagonito	T	Obeña 7119 (PBDH)	
		Prismatomeris tetranda ssp. *tetranda*	No recorded common name	S/T		Pelser et al. (2011-onwards)
		Psychotria sp.	No recorded common name	T		
	Lamiaceae	*Vitex turczaninowii* Merr.	Kolipapa	T	Obeña 7120 (PBDH)	
	Acanthaceae	*Strobilanthes bulusanensis* Elmer	No recorded common name	S		Pelser et al. (2011-onwards)
		Gymnostachyum affine Nees	No recorded common name	S		
	Araliaceae	*Polyscias nodosa* (Blume) Seem.	Bongliw	T	Obeña 7112 (PBDH)	
	Stemonuraceae	*Gomphandra fernandoi* Schori & Utteridge	No recorded common name	S/T		Schori M & Utteridge TMA, 2012
		Gomphandra mappioides Valeton	No recorded common name	S/T		Pelser et al. (2011-onwards)
	Unknown	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 [1]PPG 1 (2016) and [2]APG 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 Rabori'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

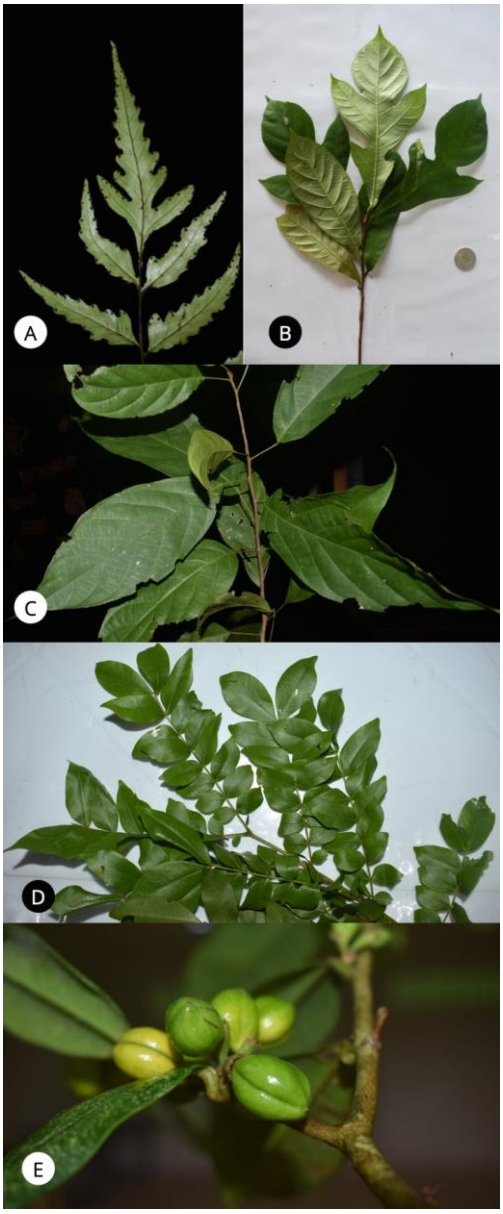

FIGURE 2. Photos showing some of the limestone flora of Paranas, Samar: A) *Tectaria calcarea* (C. Presl) Copel., B) *Artocarpus rubrovenius* Warb., C) *Hancea wenzeliana* (Slik) S.E.C.Sierra, Kulju & Welzen, D) *Wallaceodendron celebicum* Koord., and E) *Aquilaria cumingiana* (Decne.) Ridl.

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	DAO
					2017	2017-11
Blechnaceae	*Oceaniopteris egregia* (Copel.)	No recorded common name	Borneo, New Guinea, Solomon Isls, Philippines. Mindanao: Bukidnon, Davao Oriental, Misamis Occidental, North Cotabato, Palawan	Pelser et al. (2011-onwards); Copeland EB, 1960	-	VU
Annonaceae	**Goniothalamus cf. lancifolius* Merr.	No recorded common name	Native to the Philippines	Plants of the World Online	EN	-
Annonaceae	**Orophea cumingiana* S. Vidal	Amúnat, Karasákat, Lanután, Lobánti, 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
Myristicaceae	**Horsfieldia ardisiifolia* (A.DC.) Warb.	No recorded common name	Luzon, Mindoro, Sibuyan, Leyte, Samar	Pelser et al. (2011-onwards)	VU	VU
	**Horsfieldia samarensis* W.J.de Wilde	No recorded common name	Samar: Eastern Samar	Pelser et al. (2011-onwards)	CR	VU
	Knema stellata ssp. stellata	No recorded common name	Samar forests	Pelser et al. (2011-onwards)	VU	VU
	**Myristica pilosigemma* W.J.de Wilde	No recorded common name	Samar: Western Samar (Mt. Sohoton), Mindanao	Pelser et al. (2011-onwards)	CR	-
Araceae	**Alocasia zebrina* Schott ex Van Houtte	Handuroy	Luzon: Laguna, Quezon, Bicol, Sorsogon, Leyte, Samar, and Mindanao	Briones and Cuevas 2013; Hay 1999	NE	VU
Arecaceae	**Calamus aitae* Fernando	Ulisi (Biliran), Ulasi (Samar), Inhian (Agusan del Sur)	Native to the Philippines	Plants of the World Online	NE	NT
	Calamus symphysipus C. Mart.	Balnaog (Manobo), Palanog	Luzon: Sorsogon, Catanduanes, Bucas Grande, Mindanao: Agusan, SAMAR.	Pelser et al. (2011-onwards)	NE	NT
	**Calamus zollingeri* ssp. *merrillii*	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
	Caryota rumphiana Mart.	Pugahan/ Tagabunga	Philippines to Solomon Island. Samar	Adorador and Fernando 2017	LC	-
	**Heterospathe intermedia* (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	**Phrynium minutiflorum* Suksathan & Borchs.	Hagikhik (Waray)	Native to the Philippines	Plants of the World Online	NE	VU
Nepenthaceae	**Nepenthes samar* Jebb & Cheek	No recorded common name	Samar	Pelser et al. (2011-onwards)	-	CE
Clusiaceae	**Garcinia rubra* Merr.	Diis	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
			Sorsogon, Mindoro, Catanduanes, Leyte, Samar, Camiguin, Mindanao, Basilan			
Euphorbiaceae	**Tritaxis ixoroides* (C.B.Rob.) R.Y.Yu & Welzen	No common name	Luzon	Pelser et al. (2011-onwards)	-	-
Euphorbiaceae	**Hancea wenzeliana* (Slik) S.E.C.Sierra, Kulju & Welzen	Apanang	Mindanao: Surigao del Norte	Pelser et al. (2011-onwards)	CR	-
Euphorbiaceae	**Macaranga bicolor* 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)	*Wallaceodendron celebicum* Koord.	Banuyo/ 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	**Artocarpus rubrovenius* Warb.	Tugop	Batan, Luzon: Isabela, Aurora, Bataan, Pampanga, Rizal, Laguna, Batangas, Quezon, Camarines, Albay, Sorsogon, Mindoro	Pelser et al. (2011-onwards)	VU	OTS
	Ficus ampelas 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	*Oreocnide rubescens* (Blume) Miq.	Lingatong	Luzon: Laguna, Quezon to Mindanao, Indonesia	Pelser et al. (2011-onwards); Merrill (1923-1926)	LC	-
Casuarinaceae	*Gymnostoma rumphianum* (Miq.) L.A.S.Johnson	Agoho	Philippines (N. Luzon to Palawan and Mindanao), Indonesia, Papua New Guinea	Diem and Dommergues 1990	NE	OTS
Meliaceae	*Aglaia rimosa* (Blanco) Merr.	No recorded common name	Philippines: Y'AMI, Batan, 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	*Canarium hirsutum* 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	DAO 2017-11
Thymelaeaceae	*Aquilaria cumingiana* (Decne.) Ridl.	Lapnisan/ Agar	Philippines: Luzon Laguna, Catanduanes, Malaysia, Indonesia	Lee and Mohamed 2016	VU	VU
Dipterocarpaceae	**Hopea philippinensis* Dyer	Gisok	Luzon: Laguna, Quezon, Camarines, Albay, Samar, Biliran, Leyte, Panay, Negros, Samar, Mindanao: Zamboanga, Lanao, Agusan	Pelser et al. (2011-onwards)	EN	CE
Dipterocarpaceae	**Hopea quisumbingiana* Gutierrez	Quisumbing-Gisok	Samar	Pelser et al. (2011-onwards)	EN	CE
Dipterocarpaceae	**Hopea samarensis* Gutierrez	Samar Gisok	Samar	Pelser et al. (2011-onwards)	EN	CE
Dipterocarpaceae	**Shorea negrosensis* 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	VU
Anacardiaceae	*Mangifera monandra* Merr.	No recorded common name	Luzon: Ilocos Norte, Pangasinan, Zambales, Bataan, Rizal, Laguna, Camarines, Ticao, Guimaras, Leyte, Samar	Pelser et al. (2011-onwards)	NT	E
Sapindaceae	**Gloeocarpus patentivalvis* (Radlk.) Radlk. in Engl.	No recorded common name	Luzon, Leyte, Samar, Mindanao	Pelser et al. (2011-onwards)	EN	E
	**Guioa discolor* Radlk.	No recorded common name	Luzon: Isabela, Aurora, Samar	Pelser et al. (2011-onwards)	EN	VU
Apocynaceae	**Kibatalia merrilliana* Woodson	No recorded common name	Leyte, Samar	Pelser et al. (2011-onwards)	EN	VU
	**Kibatalia puberula* Merr.	No recorded common name	Samar	Pelser et al. (2011-onwards)	EN	E
Lamiaceae	*Vitex turczaninowii* 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	-
Araliaceae	*Polyscias nodosa* (Blume) Seem.	Bongliw	Luzon: Benguet, Pangasinan, Zambales, Bataan, Rizal, Quezon, Laguna, Batangas, Sorsogon, Palawan, Leyte, Basilan, Mindanao. Australia, Indonesia, Solomon Islands	Philipson 1979; Merrill (1923-1926)	LC	-
Stemonuraceae	*Gomphandra mappioides* Valeton	No recorded common name	Lesser Sunda Isls, Sulawesi, Moluccas, Philippines. Luzon: Sorsogon, Negros, Bohol, Leyte, Samar, Mindanao: Davao	Pelser et al. (2011-onwards)	LC	-

*Philippine endemic
**Conservation Status: VU – Vulnerable, EN – Endangered, NT – Near Threatened, OTS – Other Threated 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	*Platymantis corrugatus* Duméril, 1853	Philippine Wrinkled Ground Frog	Philippine endemic	LC	None	Fieldwork
		Platymantis guentheri Boulenger, 1882	Gunther's Wrinkled Ground Frog	Mindanao PAIC endemic	LC	None	Fieldwork
		Platymantis rabori Brown, Alcala, Diesmos, and Alcala, 1997	Rabor's Forest Frog	Mindanao PAIC endemic	LC	VU	Fieldwork
		Platymantis bayani Siler, Alcala, Diesmos, and Brown, 2009	Walter's Limestone Frog	Mindanao PAIC endemic	DD	VU	Fieldwork; Siler et al. 2009
Reptiles							
Squamata	Agamidae	*Draco ornatus* Gray, 1845	White Spotted Flying Lizard	Mindanao PAIC endemic	LC	None	Fieldwork; McGuire & Alcala 2000
		Draco reticulatus Günther, 1864	Günther's flying lizard	Philippine endemic	LC	None	Fieldwork; McGuire & Alcala 2000
	Scincidae	*Eutropis multifasciata* Kuhl, 1820	Common Mabuya	Resident	LC	None	Fieldwork
		Eutropis multicarinata Gray, 1845	Two-striped Mabouya	Resident	DD	None	Fieldwork
	Gekkonidae	*Cyrtodactylus sumuroi* Welton, Siler, Linkem, Diesmos & Brown, 2010	None	Mindanao PAIC endemic; Samar Island	NA	None	Siler et al. 2010; Welton et al. 2010a,b
	Colubridae	*Lycodon dumerilii* Boulenger, 1893	Duméril's Asian Wolf Snake	Mindanao PAIC endemic	LC	None	Fieldwork
		Stegonotus muelleri Duméril, Bibron & Duméril, 1854	Muller's ratsnake	Mindanao PAIC endemic	NT	None	Fieldwork
	Lamprophiidae	*Psammodynastes pulverulentus* Boie, 1827	Philippine Mock Viper	Resident	NA	None	Fieldwork
	Pareidae	*Aplopeltura boa* Boie, 1828	Bluntheaded Slug Snake	Resident	LC	None	Fieldwork
Birds							
Accipitriformes	Accipitridae	*Nisaetus pinskeri* Preleuthner & Gamauf, 1998	Pinsker's Hawk-Eagle	Philippine endemic	EN	EN	Kearns, M. 2016d
		Pernis ptilorhynchus Temminck, 1821	Oriental Honey-buzzard	Resident	LC	None	Dy, I. 2016d
		Spilornis holospilus Vigors, 1831	Philippine Serpent-Eagle	Philippine endemic	LC	None	Dy, I. 2016b
Bucerotiformes	Bucerotidae	*Buceros hydrocorax semigaleatus* Tweeddale, 1878	Southern Rufous Hornbill	Mindanao PAIC endemic	VU	EN	Fieldwork
		Penelopides affinis samarensis 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	*Collocalia esculenta* ssp. *marginata* Salvadori, 1882	Philippine glossy swiftlet	Resident	LC	None	Fieldwork
		Collocalia troglodytes Gray, 1845	Pygmy Swiftlet	Philippine endemic	LC	None	Rathgeber, M. 2017
	Caprimulgidae	*Lyncornis macrotis* Vigors, 1831	Great Eared-Nightjar	Resident	LC	None	Cooleman, S. 2016b
		Caprimulgus manillensis Walden, 1875	Philippine Nightjar	Philippine endemic	LC	None	Cooleman, S. 2016b
	Podargidae	*Batrachostomus septimus* Tweeddale, 1877	Philippine Frogmouth	Philippine endemic	LC	None	Kearns, M. 2016b
Cuculiformes	Cuculidae	*Eudynamys scolopacea mindanensis* Linnaeus, 1766	Common Koel	Resident	LC	None	Fieldwork
		Centropus melanops Lesson, 1830	Black-faced Coucal	Mindanao PAIC endemic	LC	None	Francisco, R. 2012
		Centropus viridis Scopoli, 1786	Philippine Coucal	Philippine endemic	LC	None	Kearns, M. 2016c
		Surniculus velutinus Sharpe, 1877	Philippine Drongo-Cuckoo	Philippine endemic	LC	None	Cooleman, S. 2016d
		Cacomantis variolosus Vigors & Horsfield, 1826	Brush Cuckoo	Resident	LC	None	Dy, I. 2016c
Columbiformes	Columbidae	*Phapitreron brevirostris* Tweeddale, 1877	Short-billed brown dove	Mindanao PAIC endemic	LC	None	Fieldwork
		Chalcophaps indica Linnaeus, 1758	Common Emerald dove	Resident	LC	None	Fieldwork
		Macropygia tenuirostris Bonaparte, 1854	Philippine Cuckoo-Dove	Resident	LC	None	Cooleman, S. 2016b
		Ptilinopus occipitalis Gray, 1844	Yellow-breasted Fruit-Dove	Philippine endemic	LC	None	Kearns, M. 2016c
		Gallicolumba crinigera Pucheran, 1853	Mindanao Bleeding-heart	Mindanao PAIC endemic	VU	VU	Kearns, M. 2016d
Coraciiformes	Alcedinidae	*Ceyx melanurus* Kaup, 1848	Philippine Dwarf-Kingfisher	Philippine endemic	VU	VU	Taylor, J. 2013b
		Todiramphus winchelli Sharpe, 1877	Rufous-lored Kingfisher	Philippine endemic	VU	VU	Kearns, M. 2016d
		Halcyon gularis Kuhl, 1820	Brown-breasted Kingfisher	Resident	LC	None	Barcenas, B.T. 2018
	Coraciidae	*Eurystomus orientalis* Linnaeus, 1766	Dollarbird	Resident	LC	None	Taylor, J. 2013c
	Meropidae	*Merops philippinus* Linnaeus, 1766	Blue-tailed Bee-eater	Resident	LC	None	Hutchinson, R. 2015a
		Merops americanus P. L. S. Müller, 1776	Rufous-crowned Bee-eater	Philippine endemic	LC	None	Taylor, J. 2013c
Galliformes	Megapodiidae	*Megapodius cumingii* Dillwyn, 1853	Tabon Scrubfowl	Resident	LC	VU	Cooleman, S. 2016a
	Phasianidae	*Gallus gallus* Linnaeus, 1758	Red Junglefowl	Resident	LC	None	Taylor, J. 2014b
Passeriformes	Campephagidae	*Pericrocotus speciosus* 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	*Orthotomus frontalis* Sharpe, 1877	Rufous-fronted Tailorbird	Mindanao PAIC endemic	LC	None	Hutchinson, R. 2015b
		Micromacronus leytensis Amadon, 1962	Visayan Miniature tit-babbler	Mindanao PAIC endemic	DD	VU	Francisco, R. 2012
		Orthotomus samarensis Steere, 1890	Yellow-breasted Tailorbird	Mindanao PAIC endemic	NT	OTS	Taylor, J. 2013b
	Dicaeidae	*Dicaeum pygmaeum* Kittlitz, 1833	Pygmy Flowerpecker	Philippine endemic	LC	None	Hutchinson, R. 2015a
		Prionochilus olivaceus Tweeddale, 1877	Olive-backed Flowerpecker	Philippine endemic	LC	None	Taylor, J. 2013b
		Dicaeum hypoleucum Sharpe, 1876	White-bellied Flowerpecker	Philippine endemic	LC	None	Hutchinson, R. 2015b
		Dicaeum trigonostigma Scopoli, 1786	Orange-bellied Flowerpecker	Resident	LC	None	Barcenas, B.T. 2018
		Dicaeum australe Hermann, 1783	Red-keeled Flowerpecker	Philippine endemic	LC	None	Dy, I. 2016a
		Dicaeum bicolor Bourns & Worcester, 1894	Bicolored Flowerpecker	Philippine endemic	LC	None	Dy, I. 2016c
	Dicruridae	*Dicrurus striatus samarensis* Tweeddale, 1877	Short-tailed Drongo	Mindanao PAIC endemic	LC	None	Kearns, M. 2016c
	Eurylaimidae	*Eurylaimus samarensis* Steere, 1890	Visayan Broadbill	Mindanao PAIC endemic	VU	VU	Kearns, M. 2016c
	Hirundinidae	*Hirundo rustica* Linnaeus, 1758	Barn Swallow	Resident	LC	None	Arce, K. 2015
	Irenidae	*Irena cyanogastra* Vigors, 1831	Philippine Fairy-bluebird	Philippine endemic	NT	None	Barcenas, B.T. 2018
	Laniidae	*Lanius cristatus* Linnaeus, 1758	Brown Shrike	Resident	LC	None	Taylor, J. 2013a
	Locustellidae	*Megalurus palustris* Horsfield, 1821	Striated Grassbird	Resident	LC	None	Rathgeber, M. 2017
	Monarchidae	*Terpsiphone cinnamomea* Sharpe, 1877	Rufous Paradise-Flycatcher	Resident	LC	None	Barcenas, B.T. 201
		Hypothymis azurea Boddaert, 1783	Black-naped Monarch	Resident	LC	None	Dy, I. 2016c
		Hypothymis coelestis Tweeddale, 1877	Celestial Monarch	Philippine endemic	VU	CR	Arce, K. 2015
	Motacillidae	*Motacilla cinerea* Tunstall, 1771	Gray Wagtail	Resident	LC	None	Hutchinson, R. 2015a
	Muscicapidae	*Ficedula basilanica* Sharpe, 1877	Little Slaty Flycatcher	Mindanao PAIC endemic	VU	VU	Dy, I. 2016c
		Cyornis ruficauda Sharpe, 1877	Rufous-tailed jungle-flycatcher	Resident	LC	None	Arce, K. 2015
	Nectariniidae	*Leptocoma sperata* Linnaeus, 1766	Purple-throated Sunbird	Resident	LC	None	Rathgeber, M. 2017
		Cinnyris jugularis 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	
		Aethopyga pulcherrima Sharpe, 1876	Metallic-winged Sunbird	Mindanao PAIC endemic	LC	None	Kearns, M. 2016c
		Aethopyga bella Tweeddale, 1877	Handsome Sunbird	Philippine endemic	LC	None	Hutchinson, R. 2015b
		Arachnothera clarae Blasius, 1890	Naked-faced Spiderhunter	Philippine endemic	LC	None	Hutchinson, R. 2015b
		Anthreptes griseigularis Tweeddale, 1878	Gray-throated Sunbird	Philippine endemic	LC	OTS	Taylor, J. 2014a
	Oriolidae	*Oriolus steerii* Sharpe, 1877	Philippine Oriole	Philippine endemic	LC	None	Cooleman, S. 2016c
	Pachycephalidae	*Pachycephala philippinensis* Walkden, 1872	Yellow-bellied Whistler	Philippine endemic	LC	None	Yellow-bellied Whistler
	Paridae	*Pardaliparus elegans* Lesson, 1831	Elegant Tit	Philippine endemic	LC	None	Kearns, M. 2016c
	Passeridae	*Passer montanus* Linnaeus, 1758	Eurasian Tree Sparrow	Resident	LC	None	Rathgeber, M. 2017
	Pellorneidae	*Ptilocichla mindanensis minuta* Bourns & Worcester, 1894	Striated Wren-babbler	Mindanao PAIC endemic	LC	None	Fieldwork
	Phylloscopidae	*Phylloscopus olivaceus* Moseley, 1891	Philippine Leaf Warbler	Philippine endemic	LC	None	Kearns, M. 2016c
		Phylloscopus borealis Blasius, 1858	Arctic Warbler	Resident	LC	None	Taylor, J. 2013b
	Pittidae	*Pitta steerii* ssp. *coelestis* Parkes, 1971	Steere's pitta	Mindanao PAIC endemic	VU	VU	Fieldwork
	Pycnonotidae	*Hypsipetes philippinus saturatior* E. J. O. Hartert, 1916	Philippine bulbul	Philippine endemic	LC	None	Fieldwork
		Pycnonotus urostictus atricaudatus Parkes, 1967	Yellow wattled bulbul	Philippine endemic	LC	None	Fieldwork
		Hypsipetes everetti Tweeddale, 1877	Yellowish Bulbul	Mindanao PAIC endemic	LC	None	Barcenas, B.T. 2018
		Pycnonotus goiavier Scopoli, 1786	Yellow-vented Bulbul	Resident	LC	None	Dy, I. 2016c
	Rhipiduridae	*Rhipidura nigritorquis* Vigors, 1831	Philippine Pied Fantail	Philippine endemic	LC	None	Fieldwork
		Rhipidura samarensis Steere, 1890	Visayan Blue-Fantail	Mindanao PAIC endemic	LC	None	Rathgeber, M. 2017
	Sittidae	*Sitta oenochlamys* Sharpe, 1877	Sulphur-billed Nuthatch	Philippine endemic	LC	None	Cooleman, S. 2016a
	Sturnidae	*Sarcops calvus* Linnaeus, 1766	Coleto	Philippine endemic	LC	None	Dy, I. 2016c
		Rhabdornis mystacalis Temminck, 1825	Stripe-headed rhabdornis	Philippine endemic	LC	None	Cooleman, S. 2016a
	Timaliidae	*Macronus striaticeps* 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	
	Zosteropidae	*Zosterops everetti* Tweeddale, 1878	Everett's White-eye	Resident	LC	None	Rathgeber, M. 2017
		Sterrhoptilus nigrocapitatus Steere, 1890	Black-crowned Babbler	Philippine endemic	LC	None	Kearns, M. 2016c
		Dasycrotapha pygmaea Ogilvie-Grant, 1896	Visayan Pygmy-Babbler	Mindanao PAIC endemic	NT	OTS	Kearns, M. 2016c
Piciformes	Megalaimidae	*Psilopogon haemacephalus celestinoi* Gilliard, 1949	Coppersmith barbet	Resident	LC	None	Fieldwork
	Picidae	*Yungipicus maculatus* Scopoli, 1786	Philippine Pygmy Woodpecker	Philippine endemic	LC	None	Hutchinson, R. 2015b
		Chrysocolaptes lucidus Scopoli, 1786	Buff-spotted Flameback	Mindanao PAIC endemic	LC	None	Francisco, R. 2012
Psittaciformes	Psittaculidae	*Loriculus philippensis* Müller, 1776	Philippine Hanging-Parrot	Philippine endemic	LC	CR	Rathgeber, M. 2017
Strigiformes	Strigidae	*Otus everetti* Tweeddale, 1897	Everett's Scops-Owl	Mindanao PAIC endemic	LC	None	Dy, I. 2016d
		Ninox philippensis Bonaparte, 1855	Philippine hawk-owl	Philippine endemic	LC	None	Kearns, M. 2016a
Trogoniformes	Trogonidae	*Harpactes ardens* Temminck, 1826	Philippine Trogon	Philippine endemic	LC	None	Rathgeber, M. 2017
Mammals							
Chiroptera	Pteropodidae	*Ptenochirus minor* Yoshiyuki, 1979	Lesser Musky Fruit Bat	Mindanao PAIC endemic	LC	None	Fieldwork
		Ptenochirus jagori Peters, *1861*	Greater Musky Fruit Bat	Philippine endemic	LC	None	Fieldwork
		Cynopterus brachyotis Müller, 1838	Lesser Dog-faced Fruit Bat	Resident	LC	None	Fieldwork
		Macroglossus minimus E. Geoffroy, 1810	Dagger-toothed Long-nosed Fruit Bat	Resident	LC	None	Fieldwork
Primates	Tarsiidae	*Tarsius syrichta* Linnaeus, 1758	Philippine Tarsier	Mindanao PAIC endemic	NT	OTS	Fieldwork
Rodentia	Muridae	*Rattus everetti* Günther, 1879	Philippine forest rat	Philippine endemic	LC	None	Fieldwork
		Bullimus bagobus Mearns, 1905	Bagobo rat	Mindanao PAIC endemic	LC	None	Fieldwork
		Rattus tanezumi Temminck, 1844	Oriental house rat/ Asian house rat	Resident	LC	None	Fieldwork
Dermoptera	Cynocephalidae	*Cynocephalus volans* 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.

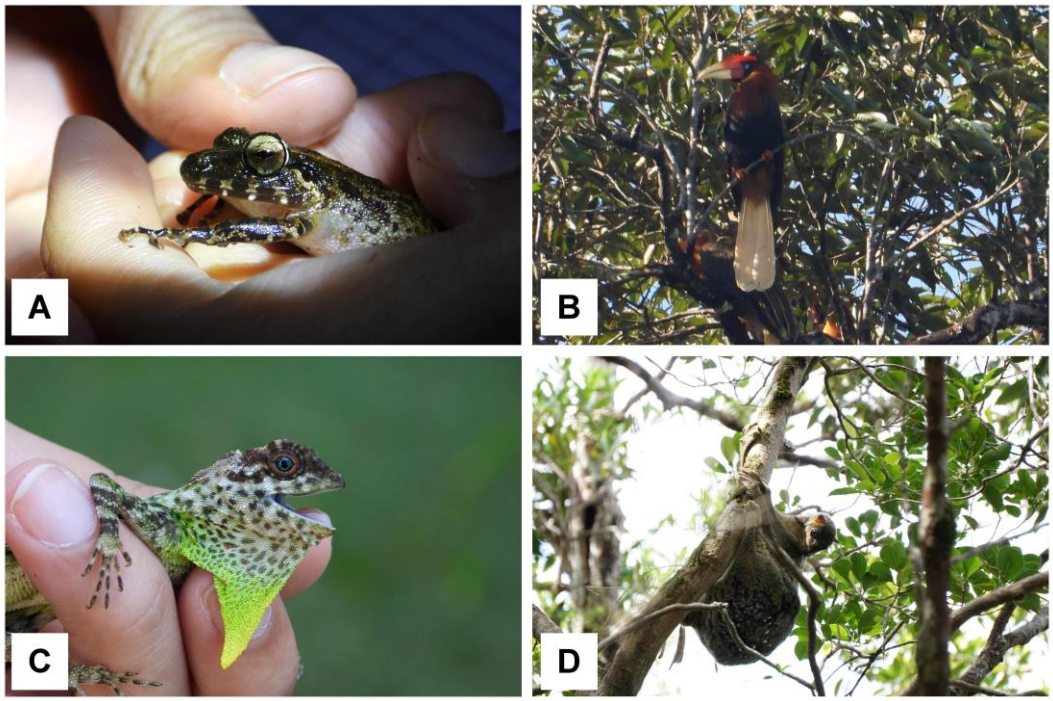

FIGURE 3. Photos of some notable forest over limestone fauna of Paranas, Samar: A) *Platymantis bayani* B) *Buceros mindanensis semigaleatus*, C) *Draco ornatus*, and D) *Cynocephalus volans.* Photographs by P.J.S. Tolentino (A, B, C) and J.T. Adorador (D).

***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 Maripipi (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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