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Tree Species Composition and Diversity in Calatrava–San Andres–San Agustin (CALSANAG) Watershed Forest Reserve, Tablas Island, Philippines

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ABSTRACT

The complex geological and biogeographical history of Tablas Island, which belongs to the Romblon Island Group, and the ongoing illegal activities in the area may have influenced the present condition of the island's floral diversity. However, information about the flora of Tablas, particularly trees, is less common compared with the other plant groups/growth forms. Here the tree species composition and diversity in CALSANAG Watershed Forest Reserve on Tablas Island were assessed to provide implications for conservation. A 2-hectare permanent biodiversity monitoring area (PBMA) was established on the island and further divided into 200 plots, from which twelve plots were randomly selected. Ninety-four tree species belonging to 76 genera and 44 families were identified. Tablas Island has an average computed diversity value of 3.12 (i.e., high species diversity). Thirty species are Philippine tree endemics, of which eight species are potential new province record, and six species were threatened. This study should serve as baseline information that is important for the creation and implementation of conservation programs on the island. However, regular vegetation monitoring is highly recommended for a better understanding of the floral resources on the island using the established PBMA.

Keywords: tree diversity; CALSANAG Watershed, *Shorea polysperma*, Tablas Island

INTRODUCTION

The Philippine archipelago has more than 7000 islands, including Tablas, Romblon, and Sibuyan landmasses from the Province of Romblon. Tablas is the largest among the three islands of Romblon Province, characterized by high levels of terrestrial endemism (Siler et al., 2012; Brown et al., 2011). The unique geological location of Tablas in the Philippine archipelago has been of particular interest to many researchers (Goodman et al., 1995). Geologically, it is part of the North Palawan block along with the Buruanga Peninsula of the Northwest Panay Island and the Southwestern of Mindoro Island (Holloway, 1981; Zamoras & Matsuoka, 2004; Zamoras et al., 2008). Further, geological history showed that Romblon and Tablas were connected to the exclusion of the Sibuyan during the Pleistocene period (Voris, 2000). Consequently, this complex geological history, with the potential effect of the sea-level oscillations during the Pleistocene period, may have played an important role in the present condition of tree species composition and diversity on Tablas Island. Despite that, information about the island's forest tree species is less common compared with the other plant groups/growth forms. It was first studied extensively only during the American period, and Merrill and other American botanists (Merrill, 1907; Ames, 1908; Copeland, 1907) led most of the studies.

With a total area of about 2700 ha, the CALSANAG or Calatrava–San Andres–San Agustin Watershed Forest Reserve is one of the Philippine protected areas under the NIPAS (National Integrated Protected Areas System) Act of 1992. The watershed, which was once covered with forests, is the only existing watershed and remaining second-growth forest on Tablas Island. However, continued forest destructions such as sporadic kaingin making, timber poaching for lumber and boat hull, illegal occupancy, forest fire, unsustainable harvesting practices of non-timber forest products such as rattans, vines, and illegal hunting of wildlife are rampant in the area. Further, coconut and tiger grass plantations are also rapidly taking over large forested areas. In a broader context, this continued forest destruction may also threaten the faunal biodiversity and other organisms on the island.

OBJECTIVES OF THE STUDY

Studying the forest tree composition and diversity of a geologically unique landmass such as Tablas Island is important as a basis for forest and biodiversity conservation. Thus, the study aimed at assessing the tree species composition and diversity on Tablas Island to provide implications for the conservation in the area.

MATERIALS AND METHODS

Description of the Study Site

Sampling was carried out in the CALSANAG Watershed Forest Reserve, Romblon, in the wet season of November 2018 (Figure 1). The watershed, with an elevation range of 300-350 m asl and an inclination of > 50%, is the only existing watershed in Romblon. Further, it is dominated by grassland, open land, coconut land, brushlands, pastures, and cultivated land; only 36 % (968 ha) is considered a residual forest. The soil in the study site belongs to the *Lonos* series and is classified as *Typic Eutrudepts* (Carating et al., 2014). The surface soil (up to 20 cm depth) is sandy loam, non-plastic and non-sticky when wet, coarse granular structure with the presence of some metamorphic pebbles and stones.

The subsoil (60 cm) and substratum (150 cm) are sand clay loam (Castillo et al., 1973).

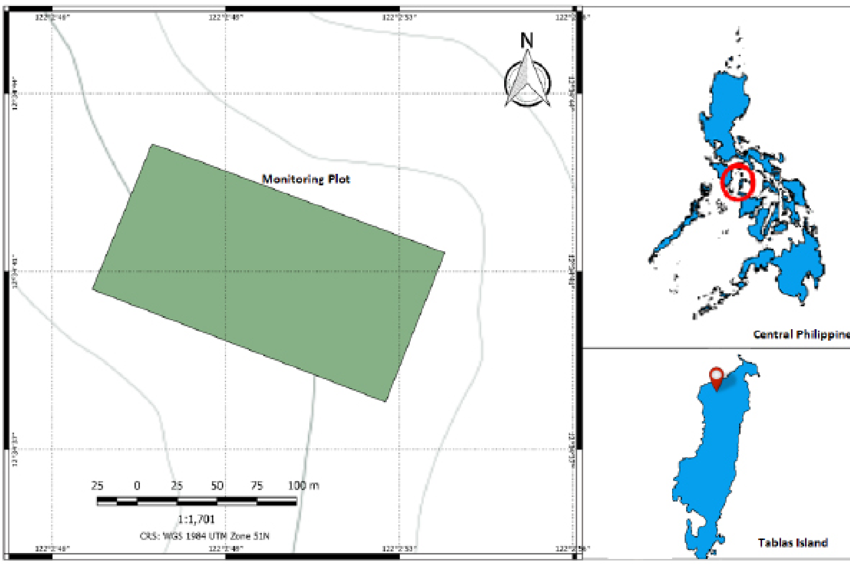

Figure 1. Location of the study site in Tablas Island, Romblon, Philippines.

Climatic Conditions

The monthly temperature, relative humidity (RH), and precipitation data were obtained using a microclimate sensor installed near the study site. In 2017-2018, the highest temperature was observed in summer (mid-March to August, c.a. 30-37° C), and the lowest temperature was observed from December to mid-February, that is, 21-25 ° C (Figure 2). There was no much difference in relative (RH) across months. Mean annual precipitation ranged from 2,203-2230 mm; the highest and lowest monthly precipitation was observed from January to April (Figure 2).

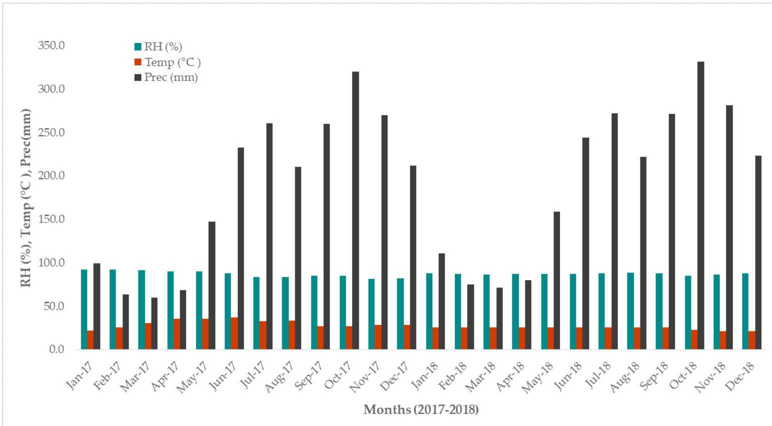

Figure 2. Monthly temperature (Temp), relative humidity (RH), and precipitation (PREC) in CALSANAG Watershed, Tablas Island from 2017 to 2018.

Establishment of Sampling Plots

A 2.0 hectare (100m x 200m) Permanent Biodiversity Monitoring Area (PBMA) was established in the study site and further divided into 200 plots with an area of 100 m2 each (Figure 3). All quadrats were assigned a unique name, which served as the identification number of each tree encountered within each plot. Out of the 200 plots in the PBMA, twelve plots were randomly selected (i.e., 86, 90, 141, 90, 146, 150, 191, 195, 200, 31, 35, 40, 81, 86). The PBMA could serve as a representative of the ecosystem of Tablas Island for present and future studies.

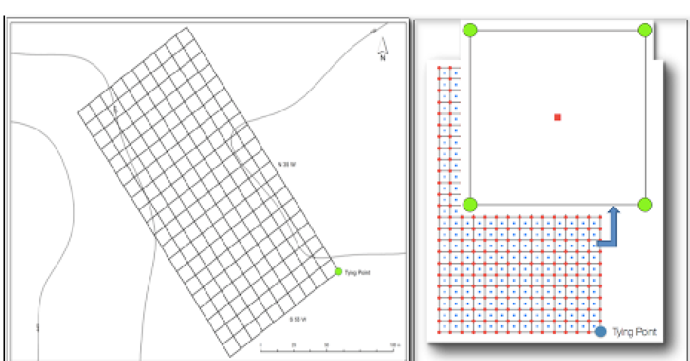

Figure 3. The established Permanent Biodiversity Monitoring Area (PBMA) and sampling plots in CALSANAG Watershed, Tablas Island from 2017 to 2018.

Tree Survey and Measurements

To determine the forest structure of the site, the Diameter at Breast Height (DBH), tree heights, basal area, and count and frequency of individuals were measured and computed. The researchers only selected trees with ≥ 1 cm DBH with the use of a diameter tape. The tree height measurement was done through estimation. Trees were then categorized into (1) poles and saplings, (2) small-size trees, and (3) medium-size trees.

Leaf samples for every individual plant encountered within each plot were collected and tagged. The collected samples were wet-pressed in the site using denatured alcohol and were brought to the laboratory for proper identification after oven-drying at 65°C for 2-3 days. The identification was made by consulting an expert. Other means of leaf identifications were also explored, including the use of herbarium samples and online materials (e.g., Co's Digital Flora of the Philippines and Plant List). The species name of each species was verified through the accepted name in the Plant List Database (www.theplantlist.org). Common names were adapted from Rojo and Salvosa (1999).

Identification of Conservation Status

In this study, the identification of the conservation status was made only for Philippine endemic tree species. At the local scale, the DAO-2017-11 was used to determine the conservation status of endemic species, while the IUCN Red List-2019-3 for the global scale.

Data Analysis: Plant species density, dominance, frequency, and importance value index

The vegetation analysis was done by calculating the relative density, relative dominance, and relative frequency following the formulae used in Combalicer et al. (2018). The ecological importance of species in its habitat was computed by summing up the three relative values (Curtis & Macintosh, 1951).

Diversity of Plant Species

The diversity indices [Shannon (H'), Simpson's (D), and Evenness index (J)] were computed in the Multivariate Statistical Software (MVSP ver. 3) using the density values of respective tree species and count of tree individuals for each plot. The endemism of species was determined using the book of Rojo and Salvosa (1999) and Co's Digital Flora of the Philippines (Pelser et al., 2011).

RESULTS AND DISCUSSION

Species Diversity

Based on the Shannon diversity index classification, Tablas Island has an average computed diversity value of 3.12 (Table 1), with a relative value of high species diversity (MacDonald, 2003). It is consistent with the obtained values of Simpson's Index, i.e., 0.855 (MacDonald, 2003). The results of the two diversity indices suggest that Tablas Island has a high species diversity and evenness index of 0. 831 (i.e., 83 % of species are common among the twelve plots). These results are consistent with the pattern reported for a lowland mixed dipterocarp forest in Indonesia (Wilkie et al., 2004) and a Philippine lowland rainforest (Lillo et al., 2019; Landgenberger et al., 2006; Fernando et al., 2008). Ultramafic mountain forest in Mount Guiting-Guiting on Sibuyan Island, Romblon Province, has also shown high species richness (i.e., > 111 tree species) per 0.25-ha plot (Proctor et al., 1998). In Dinagat Island in Mindanao, an average of 3.32 species diversity has also been reported for different forest habitat types, such as tropical lowland evergreen rain forest, tropical lower montane rain forest, tropical upper montane rain forest, tropical subalpine forest, and forest over limestone (Lillo et al., 2019). Our results are expected, considering that the sampled forest is neither high nor low in elevation. Moreover, geographic and edaphic characteristics of islands have already been shown to provide clear evidence of specific biological processes associated with their spatial isolation compared to other habitat areas (Martin-Queller et al., 2017).

The present study did not include other plant growth forms (e.g., herbs, shrubs); hence, the plant species diversity on the island may be higher than what we have reported, suggesting that further diversity-and-ecology-related studies in the area are very important for developing site conservation and management programs using the established PBMA. One of the community attributes is species diversity, which influences ecosystem stability, productivity, and tropic structure (Tilman, 1996).

Table 1

Species diversity values (Shannon, Simpson, and Evenness) of the twelve plots in CALSANAG Watershed on Tablas Island

	Diversity Indices		
Plot	**Shannon (H')**	**Simpson's (D)**	**Evenness (J)**
PLOT31	3.799	0.894	0.877
PLOT35	3.303	0.722	0.988
PLOT40	2.54	0.983	0.786
PLOT81	2.525	0.988	0.789
PLOT86	3.04	0.736	0.867
PLOT90	3.713	0.889	0.897
PLOT141	3.122	0.896	0.763
PLOT146	2.575	0.827	0.792
PLOT150	3.872	0.834	0.873
PLOT191	2.692	0.832	0.779
PLOT195	3.553	0.928	0.816
PLOT200	2.762	0.733	0.756
Average	**3.124**	**0.855**	**0.831**

Stand Structure and Importance Value Index

A total of 375 tree individuals belonging to 94 species, 76 genera, and 44 families were identified from the twelve randomly selected plots in the PBMA (Table 2). Results showed that poles and saplings dominated the forest in terms of number, with 73 percent of the total number of individuals. It can be ascribed to the series of logging operations in the past, giving the island a relatively young forest stand. The result also suggests that active tree regeneration in the area is taking place. Among the 44 families identified, Rubiaceae (coffee family) has the highest number of species. Rubiaceae species are often distributed in the tropics and dominate the rainforests, with *c.a.* 660 genera and 13 species of various growth forms (Robbrecht, 1988; Alejandro, 2007). The families with the highest number of tree individuals are Dipterocarpaceae, followed by Sapotaceae, Myrtaceae, and Rubiaceae, consistent with the result reported in Proctor et al.

(1998). In forests, those with the highest IV are the dominant trees, followed by the co-dominants, the intermediates, and the small trees. Although most of the stems of *Shorea polysperma* (Tanguile) belong to the saplings diameter class, it was found that it is still the most dominant tree in the area with the IV of 48.1 percent. This may imply that the Tablas Island was once *S. polysperma*-dominated lowland dipterocarp forest, considering many stumps of large-size trees (*c.a.* not lower than 100 cm DBH) of *S. polysperma* in the study site. The dominance of Dipterocarpaceae on the island is consistent with the usual reported pattern of dominance of species under the family Dipterocarpaceae in the dipterocarp rainforests (Budi, 1996). Further, the observed higher IV of *S. polysperma* could be explained by its biological and ecological characteristics. The record description of the species showed that it has the highest production of fruits among Dipterocarpaceae species, with an efficient mode of seed dispersal, i.e., anemochory (Appanah & Turnbull, 1998). In this assessment, *S. polysperma* was followed by *Syzygium merritianum* co-dominant (IV=29.27%). A study by Okuda et al. (2003) observed the same pattern, such that the *Shorea* species dominates the Pasoh Forest Reserve in Malaysia in association with the high dominance of *Syzygium* species and *Litsea* species. This pattern observed in *Syzygium merritianum* can partly be attributed to its seed dispersal mode, that is, zoochorous. This seed dispersal mode plays an important role in the persistence of populations, which is a fundamental strategy involved in the organization and maintenance of species richness and abundance in a particular habitat (Tadwalkar et al., 2012; Condit et al., 2002; Chave et al., 2002).

The third dominant species was the *Palaquium glabrum* (IV=20.88%) from the Sapotaceae family. Based on many biodiversity assessments, Sapotaceae species are usually the co-dominants of Dipterocarpaceae species. In Southeast Asian and Pacific regions, Sapotaceae species, with more than 1100 species belonging to c.a. 50 genera, are usually ranked next to Dipterocarpaceae in terms of dominance (Budi, 1996). In this study, the high dominance of *P. glabrum* can be contributed largely by its higher basal area compared to the other identified species. Also, Sapotaceae fruits are dispersed by trogons and hornbills that eat the lipid-rich exocarps and mesocarps of a fruit (Parrado-Rosselli, 2002; Ali & Ripley, 1983; Leighton & Leighton, 1983), which makes the dispersal of seeds very efficient for *P. glabrum*.

Table 2

List of tree species surveyed in CALSANAG Watershed, Tablas Island, Philippines

SCIENTIFIC NAME	RDEN	RFREQ	RDOM	IV
AGAVACEAE				
Dracaena angustifolia (Medik.) Roxb.	0.65	0.46	0.28	1.38
ANACARDIACEAE				
Mangifera sp.	0.33	1.36	0.02	1.71
Mangifera altissima Blanco	1.62	0.46	0.65	2.72
Mangifera odorata Griff.	0.33	1.36	0.04	1.73
Mangifera altissima Blanco	0.97	0.46	0.06	1.49
Mangifera monandra Merr.	0.33	0.46	0.00	0.78
Parishia maingayi Hook.f.	1.62	0.46	0.77	2.84
Parishia malabog Merr.	0.33	0.46	0.02	0.80
ANNONACEAE				
Desmos sp.	0.33	1.36	0.00	1.69
Goniothalamus gitingensis Elmer	0.65	0.46	0.02	1.13
Polyalthia sp.	0.33	1.82	0.03	2.17
APOCYNACEAE				
Kibatalia blancoi (Rolfe ex Stapf) Merr.	2.92	0.46	3.68	7.05
Kibatalia gitingensis (Elmer) Woodson	0.33	1.82	0.11	2.26
ARALIACEAE				
Arthrophyllum ahernianum Merr.	1.95	1.36	0.94	4.25
Osmoxylon pulcherrimum Vidal ex Fern.-Vill.	0.33	0.46	0.02	0.80
Schefflera sp.	0.33	0.91	0.00	1.23
BIGNONIACEAE				
Radermachera gigantea (Blume) Miq.	0.65	0.46	0.09	1.19
BURSERACEAE				
Canarium odontophyllum Miq.	1.95	1.82	1.17	4.93
Dacryodes incurvata(Engl.) H.J.Lam	3.25	0.46	2.20	5.90
CALOPHYLLACEAE				
Calophyllum blancoi Planch. & Triana	0.65	1.82	0.09	2.55
CARDIOPTERIDACEAE				
Gonocaryum calleryanum (Baill.) Becc.	0.33	0.91	0.00	1.23
CELASTRACEAE				
Bhesa paniculata Arn.	0.65	0.91	0.28	1.84
Euonymus cochichinensis Franch.	0.65	0.46	0.08	1.18
Lophopetalum javanicum	1.30	2.73	0.33	4.36
COMBRETACEAE				
Terminalia nitens C.Presl	0.97	0.46	0.67	2.10
DICHAPETALACEAE				
Dichapetalum gelanoides ssp. *tuberculatum*(Roxb.) Engl.	1.30	0.46	2.30	4.05
DIPTEROCARPACEAE				
Shorea polysperma Merr.	8.77	5.00	34.37	48.13

Table 2 continued.

SCIENTIFIC NAME	RDEN	RFREQ	RDOM	IV
EBENACEAE				
Diospyros sp.	0.33	0.91	0.00	1.23
ELAEOCARPACEAE				
Elaeocarpus gitingensis Elmer	0.65	0.91	0.04	1.60
EUPHORBIACEAE				
Codiaeum variegatum var.moluccanum(L.) Rumph. ex A.Juss.	0.33	1.36	0.00	1.69
Omphalea sp.	0.65	0.46	0.24	1.35
Trigonostemon sp.	0.33	0.91	0.03	1.26
FABACEAE				
Ormosia macrodisca Baker	0.33	0.46	0.13	0.91
GENTIANACEAE				
Fagraea racemosa Jack	0.33	0.46	0.03	0.81
LAURACEAE				
Beilschmiedia gitingensis (Elmer) Kosterm.	0.65	0.91	0.17	1.73
*Cinnamomum microphyllum*Ridl.	0.33	0.46	0.09	0.87
Cryptocarya sp.	0.97	3.64	0.88	5.49
Litsea sp.	0.65	0.46	0.12	1.23
LOGANIACEAE				
Strychnos ignatii P.J. Bergius	0.65	0.46	0.02	1.13
MAGNOLIACEAE				
Magnolia sp.	0.65	0.46	0.52	1.63
MALVACEAE				
Leptonychia sp.	0.33	0.91	0.02	1.26
MELASTOMATACEAE				
Astronia gitingensis Elmer	0.65	0.91	0.06	1.62
Astronia viridifolia Elmer	0.33	0.46	0.07	0.85
MELIACEAE				
Aglaia aherniana G.Perkins	1.62	1.36	0.67	3.66
MORACEAE				
Ficus lucbanensis Elmer	0.33	0.46	0.02	0.80
Ficus ruficaulis Merr.	0.33	0.91	0.05	1.28
Parartocarpus venenosus ssp. papuanus	0.65	1.36	0.18	2.20
MYRISTICACEAE				
Gymnacranthera farguhariana var. zippeliana	0.65	0.46	0.45	1.55
Knema glomerata (Blanco) Merr.	1.95	0.46	0.86	3.26
Myristica philippensis Lam.	0.65	0.46	0.13	1.23
MYRTACEAE				
Syzygium mauritsii Govaerts	0.33	0.46	0.09	0.87
Syzygium merrittianum (C.B.Rob.) Merr.	7.14	5.46	16.67	29.27
Syzygium myrtifolium Walp.	0.65	0.91	0.17	1.73

Table 2 continued.

SCIENTIFIC NAME	RDEN	RFREQ	RDOM	IV
OPILIACEAE				
Champereia manillana (Blume) Merr.	0.33	0.46	0.08	0.86
PENTAPHYLLACEAE				
Ternstroemia gitingensis Elmer	0.65	0.91	0.09	1.65
PHYLLANTHACEAE				
Baccaurea philippinensis (Merr.) Merr	3.25	2.27	3.16	8.68
Baccaurea tetrandra (Baill.) Müll.Arg.	0.65	0.46	0.29	1.40
Glochidion rubrum Blume	1.30	0.46	1.05	2.80
Sauropus robinsonii Merr.	0.33	0.46	0.05	0.82
Sauropus villosus (Blanco) Merr.	0.33	0.46	0.03	0.81
PODOCARPACEAE				
Nageia wallichiana (C.Presl) Kuntze	0.65	0.91	0.16	1.72
PRIMULACEAE				
Ardisia angustifolia ADC	1.30	0.91	0.43	2.64
Discocalyx pachyphylla Merr	0.65	0.46	0.04	1.14
PUTRANJIVACEAE				
Drypetes sibuyanensis (Elmer) Pax & K.Hoffm	0.33	0.91	0.00	1.23
ROSACEAE				
Prunus grisea var. tomentosa	1.95	0.46	2.88	5.28
RUBIACEAE				
Canthium sp.	1.63	0.92	0.93	3.46
Dolicholobium philippinense Trel.	0.33	0.46	0.07	0.85
Gardenia elata var.elata Ridl.	0.65	0.46	0.08	1.19
Garcinia rhizophoroides Elmer	0.33	0.91	0.02	1.25
Greeniopsis discolor Merr.	2.92	1.36	2.62	6.91
Mussaenda magallanensis Elmer	0.33	0.91	0.02	1.25
Ophiorrhiza sp. L.	0.65	0.91	0.06	1.62
Psychotria sp.	0.65	0.91	0.11	1.67
Wendlandia sibuyanensis Cowan	0.97	5.46	0.45	6.88
RUTACEAE				
Melicope blancoi T.G.Hartley	0.33	0.46	0.02	0.80
Melicope monophylla Merr.	0.33	0.46	0.16	0.94
Micromelum falcatum (Lour.) Tanaka	0.65	0.46	0.18	1.29
SALICACEAE				
Homalium gitingense	0.33	2.73	0.04	3.09
SAPINDACEAE				
Guioa pleuropteris (Blume) Radlk.	1.62	0.91	0.29	2.82
Mischocarpus pentapetalus (Roxb.) Radlk.	1.30	0.46	0.22	1.98
Trigonachras cultrata (Turcz.) Radlk	0.65	0.46	0.10	1.20

Table 2 continued.

SCIENTIFIC NAME	RDEN	RFREQ	RDOM	IV
SAPOTACEAE				
Madhuca multiflora (Merr.) J.F.Macbr.	5.52	0.91	7.25	13.68
Mimusops elengi L.	0.33	1.36	0.00	1.69
Palaquium ahernianum Merr.	0.33	0.46	0.03	0.81
Palaquium abundantiflorum H.J.Lam.	0.33	3.64	0.00	3.96
Palaquium glabrum Merr.	5.52	8.91	6.45	20.88
SPARMANNIACEAE				
Microcos stylocarpa Burret	0.33	0.91	0.00	1.23
STEMONURACEAE				
Gomphandra cumingiana (Miers) Fern.-Vill.	0.33	1.36	0.02	1.71
Gomphandra luzoniensis (Merr.) Merr.	0.97	0.91	0.11	1.99
STERCULIACEAE				
Sterculia rubiginosa var. setispula	0.65	2.73	0.10	3.48
STROMBOSIACEAE				
Strombosia philippinensis S.Vidal	3.25	0.46	2.45	6.15
THYMELACEAE				
Gonystylus macrophyllus (Miq.) Airy Shaw	0.65	2.73	0.05	3.43
Phaleria sp.	0.33	0.46	0.00	0.78

RDEN – Relative Density; **RFEQ** – Relative Frequency; **RDom** – Relative Dominance; **IV** – Importance Value

Conservation Status of Philippine Endemic species

Of the 94 species observed, 30 species (32%) are Philippine tree endemics (Table 3). Seven out of the total endemic species were found dominant in the island within the following order: *S. polysperma* > *S. merrittianum* > *P. glabrum* > *Madhuca multiflora* > *Baccaurea philippinensis* > *Kibatalia blancoi* > and *Greeniopsis discolor*. Among the listed endemic species, one species is critically endangered (CR), three vulnerable species (VU), and one other threatened species (OTS) using the latest DENR classification (DAO-2017-11). This represents 0.61 percent of the 984 threatened plant species in the Philippines.

Using the IUCN classification, one species is recorded as critically endangered, one species considered as endangered, five as vulnerable species, two least concern species, and the majority of the endemic species not yet been assessed by the IUCN. The conservation status of some species does not match with those of the DAO 2017-11 list. In the IUCN method of classification, the *S. polysperma* is recorded as a critically endangered species, but the species is still under the vulnerable category under the DAO 2017-11. *M. monandra* is already an endangered species under IUCN but treated as a vulnerable species in the DENR records. The inconsistency in the conservation status of the species between IUCN and DENR DAO can be attributed to a wider scope of the former (i.e., global scale). In contrast, the DENR DAO is only performed at the local scale.

Moreover, eight of the identified endemic species are potentially new records in the province of Romblon, namely, *C. microphyllum*, *D. pachyphylla*, *G. discolor*, *M. multiflora*, *M. monandra*, *M. blancoi*, *P. abundantiflorum*, and *P. glabrum* (Table 3). While Sibuyan Island is one of the priority areas for plant conservation or Important Plant Areas in the Philippines, little or no attention is given to the unique forest ecosystems and vulnerable biodiversity on Romblon-Tablas Island (DENR-PAWB, 2006; GEF, 2008), even though it is one of the areas in the Philippines where the country's highest numbers of threatened species occur (GEF, 2008). Moreover, to our knowledge, no tree diversity study and extensive forest conservation programs have yet been fully implemented on Tablas Island as of this writing.

Table 3

Philippine endemic tree species recorded from CALSANAG Watershed, Tablas Island, Philippines

Scientific Name	Common Name	Record	Conservation status
Aglaia aherniana	Alamag		OTS (DAO); VU (IUCN)
Astronia gitingensis	Dungau-gulod		NE (IUCN)
Astronia viridifolia	Dalipos		NE (IUCN)
Baccaurea philippinensis	Baloiboi		LC (IUCN)
Beilschmiedia gitingensis	Bagaoring		NE (IUCN)
Cinnamomum microphyllum	Kalingag-liitan	NPR	VU (IUCN)
Discocalyx pachyphylla	Pagingang-kapalan	NPR	NE (IUCN)
Dolicholobium philippinense	Tungau-tungau		NE (IUCN)
Elaeocarpus gitingensis	Saritan		NE (IUCN)
Garcinia rhizophoroides	Bogaiat		NE (IUCN)
Greeniopsis discolor	Pangalimanan	NPR	CE (DAO)
Homalium gitingense	Bunguas		NE (IUCN)

Table 3 continued.

Scientific Name	Common Name	Record	Conservation status
Kibatalia blancoi	Pasnit		NE (IUCN)
Kibatalia gitingensis	Leneteng gubat		VU (IUCN)
Knema glomerata	Tambalau		LC (IUCN)
Madhuca multiflora	Kalamianes	NPR	NE (IUCN)
Mangifera monandra	Malapaho	NPR	VU (DAO); EN (IUCN)
Melicope blancoi		NPR	NE (IUCN)
Mussaenda magallanensis	Agboi		VU (DAO); NE (IUCN)
Myristica philippensis	Duguan		OTS (DAO); VU (IUCN)
Osmoxylon pulcherrimum	Paladukai		NE (IUCN)
Palaquium abundantiflorum	Tagkan-kalau	NPR	NE (IUCN)
Palaquium glabrum	Alakaak-puti	NPR	NE (IUCN)
Parishia malabog	Malabog		NE (IUCN)
Shorea polysperma	Tanguile		VU (DAO); CE (IUCN)
Syzygium mauritsii			NE (IUCN)
Syzygium merrittianum	Tumolad		NE (IUCN)
Terminalia nitens	Sakat		VU (IUCN)
Trigonachras cultrata	Darunga		NE (IUCN)
Wendlandia sibuyanensis	Ladko		NE (IUCN)

NPR – New province record; **CR** – Critically endangered; **VU** – Vulnerable; **NE** – Not evaluated; **OTS** - Other Threatened Species; **LC** - Least concern; **IUCN** – International Union for Conservation of Nature and Natural Resources; **DAO** – DENR Department Order. All IUCN and DAO conservation statuses were based on IUCN 2019-3 and DAO 2017-11, respectively.

CONCLUSIONS

The present study revealed that Tablas Island is home to many ecologically important species characterized by high tree diversity and species endemism. Some of the identified endemic species are also threatened based on the DAO-2017-11 and the IUCN Red Lists, needing immediate conservation. The findings of the present study should serve as the baseline information for present and future conservation programs on the island. However, regular vegetation monitoring on the island is highly recommended for a better understanding of the development of tree composition and diversity in the area using the established PBMA.

LITERATURE CITED

Alejandro, G. J. (2007). The status of Philippine Rubiaceae. *Philippine Journal of Systematic Biology,* (1), 1-15.

Ali. S., Ripley, D. S. (1983). Handbook of the Birds of India and Pakistan, together with those of Bangladesh, Nepal, Bhutan and Sri Lanka. Compact Edition. Delhi, India: Oxford University Press.

Ames, O. (1908). Orchidaceae halconenses: An enumeration of the orchids collected on or near Mount Halcon, chiefly by Elmer D. Merrill. *Philippine Journal of Science,* (2), 311-337.

Appanah J, Turnbull. (1998). A review of dipterocarps: Taxonomy, ecology and silviculture.

Brown, R.M., Siler, C.D., Oliveros, C.H., Diesmos, A.C., Alcala, A.C. (2011). A New Gekko from Sibuyan Island, Central Philippines. *Herpetologica,* (67), 460–476.

Budi, S. A. (1996). Dipterocarp Forest Ecosystems: Towards Sustainable Management. Chapter, Properties and Utilization of Sapotaceous Timber from Dipterocarp Forests (eds. Schulte A, Schone D). Singapore: Word Scientific Publishing Co. Pte. Ltd. pp 591-602.

Carating, R. B., Galanta, R. G., Bacatio, C. D. (2014). The Soils of the Philippines. *World Soils Book Series*.

Castillo, D. M., Quiro, I., Higino, M. (1973). Soil survey of Romblon Province, Philippines. Manila: Government Printing Office.

Chave, J., Muller-Landau, H.C., Levin, S. A. (2002). Comparing Classical Community Models: Theoretical Consequences for Patterns of Diversity. *The American Naturalist,* (159), 1–23.

Combalicer, M. S., Hernandez, J. O., Park, P. S., Lee, D. K. (2018). Regeneration in *Acacia mangium* Will. Plantation in Mt. Makiling Forest Reserve, Philippines: Implications to Restoration Ecology. *Acacia: Characteristics, Distribution and Uses*. New York, USA: Nova Science Publishers Inc. pp 128.

Condit, R. (2002). Beta-Diversity in Tropical Forest Trees. *Science,* (295), 666–669.

Copeland, E. B. (1907). Pteridophyta halconenses: A list of the ferns and fern-allies collected by Elmer D. Merrill on Mount Halcon, Mindoro. *Philippine Journal of Science,* (2), 119-155.

Curtis, J. T., Mcintosh, R. P. (1951). An Upland Forest Continuum in the Prairie-Forest Border Region of Wisconsin. *Ecology,* (32), 476–496.

DENR Administrative Order. (2017). Updated national list of threatened Philippine plants and their categories (DAO No. 2017 -11).

DENR–PAWB. (2006). Framework for Philippine Plant Conservation Strategy and Action Plan. Department of Environment and Natural Resources – Protected Areas and Wildlife Bureau. Quezon Avenue, Diliman, Quezon City.

Fernando, E. S., Suh, M. N., Lee, J., Lee, D. K. (2008). Forest formation of the Philippines. ASEAN Korea Environmental Cooperation Unit (AKECU). GeoBook Publishing Co.

Global Environment Facility (GEF). (2008). GEF country evaluation: the Philippines (1992-2007). Global Environment Facility Evaluation Office: Washington DC

Goodman, S. M., Gonzales, P. C., Willard, D. E. (1995). The birds of Sibuyan Island, Romblon Province, Philippines: with particular reference to elevational distribution and biogeographic affinities. Chicago, Ill.: *Field Museum of Natural History*.

Holloway, N. H. (1981). North Palawan Block, Philippines-Its Relation to Asian Mainland and Role in the Evolution of South China Sea. *Geological Society of Malaysis Bulletin,* (14), 19-58.

IUCN. (2019). IUCN updates 'red list' of endangered species.-3. https://www.iucn.nl/en/solutions/red-list-of-threatened-species.

Leighton, M., Leighton, D. R. (1983). Vertebrate responses to fruiting seasonality within a Bornean rainforest. In Tropical Rain Forests: Ecology and Management (ed. S. L. Sutton, T. C. Whitmore and A. C. Chadwick). Oxford, UK: Blackwell Scientific Publications. pp 181–196.

Lillo, E. P., Fernando, E. S., Lillo, M. J. R. (2019). Plant diversity and structure of forest habitat types on Dinagat Island, Philippines. *Journal of Asia-Pacific Biodiversity,* (12), 83–105.

MacDonald, G. M. (2003). Biogeography: space, time, and life. New York, NY: John Wiley & Sons, Inc.

Martín-Queller, E., Albert, C. H., Dumas, P., Saatkamp, A. (2017). Islands, mainland, and terrestrial fragments: How isolation shapes plant diversity. *Ecology and Evolution,* (7), 6904-6917.

Merrill, E. D. (1907). The flora of Mt. Halcon. *Philippine Journal of Science,* (2), 251-309.

Okuda, T., Manokaran, N., Matsumoto, Y., Niiyama, K., Thomas, S. C., Ashton, P. S. (2003). Pasoh: Ecology of a Lowland Rain Forest in Southeast Asia. Tokyo, Japan: Springer-Verlag.

Parrado-Rosselli, A. (2002). Effect of fruit size on primary seed dispersal of five canopy tree species of the Colombian Amazon. *Selbyana,* (23), 245-257.

Pelser, P. B., Barcelona, J. F., Nickrent, D. L. (2011). Co's Digital Flora of the Philippines. www.philippineplants.org

Proctor, J., Argent, G. C., Madulid, D. A. (1998). Forests of the ultramafic mount Giting-Giting, Sibuyan Island, the Philippines. *Edinburgh Journal of Botany,* (55), 295-316.

Robbrecht, E. (1988). Tropical Woody Rubiaceae. *Opera Botanica Belgica,* (1), 1–271.

Rojo, J. P., Salvosa, F. M. (1999). Revised lexicon of Philippine trees. College, Philippines: Forest Products Research and Development Institute, Department of Science and Technology.

Siler, C. D., Swab, J. C., Oliveros, C. H., Diesmos, A. C., Averia, L., Alcala, A. C., Brown, R. M. (2012). Amphibians and reptiles, Romblon Island group, central Philippines: comprehensive herpetofaunal inventory. *Check List,* (8), 443.

Tadwalkar, M. D., Joglekar, A. M, Mhaskari, M., Kanade, R. B., Chavan, B, Watve, A. V., Ganeshaiah, K. N., Patwardhan, A. A. (2012). Dispersal modes of woody species from the northern Western Ghats, India. *Tropical Ecology,* (53), 53-67.

Tilman, D. (1996). Biodiversity: population versus ecosystem stability. *Ecology,* (77), 350-363.

Voris, H. K. (2000). Maps of Pleistocene sea levels in Southeast Asia: shorelines, river systems and time durations. *Journal of Biogeography,* (27), 1153–1167.

Wilkie, P., Argent, G., Cambell, E., Saridan, A. (2004). The diversity of 15 ha of lowland mixed dipterocarp forest, Central Kalimantan. *Biodiversity and Conservation,* (13), 695–708.

Zamoras, L. R., Matsuoka, A. (2004). Accretion and postaccretion tectonics of the Calamian Islands, North Palawan block, Philippines. *The Island Arc ,* (13), 506–519.

Zamoras, L. R., Montes, M. G. A., Queaño, K. L., Marquez, E. J., Dimalanta, C. B., Gabo, J. A. S., Yumul, G. P. (2008). Buruanga peninsula and Antique Range: Two contrasting terranes in Northwest Panay, Philippines featuring an arc-continent collision zone. *Island Arc,* (17), 443–457.

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