

**FIRST RECORD OF *HOYA MELIFLUA* (BLANCO) MERR.
(APOCYNACEAE, ASCLEPIADOIDEAE) IN THE NATURAL
ECOSYSTEMS OF BATANGAS IN LUZON ISLAND, PHILIPPINES,
WITH NOTES ON ASSOCIATED FLORA**

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Abstract: The Philippine islands host a significantly high concentration of native and endemic *Hoya* species. However, there are no previous records of this genus in the natural ecosystems within the province of Batangas, Luzon Island. The present study pioneered the exploration of *Hoya* plants and their associated communities in Batangas. A route-walk method was employed within the forests of Lobo, Batangas, to document *Hoya* species. Morphological characteristics, habitat, host plants, substrates, and associated flora were also recorded. Only one species was identified, *Hoya meliflua* (Blanco) Merr., with material deposited in the Batangas State University – The National Engineering University Lobo Campus Herbarium (Reg. #: Pasado 001). The morphology and other plant references and databases confirmed its identity. The study found that the individuals of *H. meliflua* in Lobo inhabit the secondary riverine forests along ecotourism sites, with *Schizostachyum textorium* (Blanco) Merr., *Ficus balete* Merr., *Tectona philippinensis* Benth. & Hook.f. ex Merr. and *Pterospermum diversifolium* Blume as the major host plants. The assessment of the associated flora revealed 46 species, of which 100% were natives, 13% were Philippine endemics, and 14% were threatened nationally and internationally. The conservation of *H. meliflua* in Batangas can be improved by mainstreaming its importance as an ornamental plant and a key biodiversity species within ecotourism sites. Further studies can help in revealing the presence of other *Hoya* spp. on the island.

Keywords: Batangas province, *Hoya meliflua*, new distribution record, secondary riverine forest, Verde Island Passage

Introduction

The Philippines is a megadiversity island country with a very high degree of floral and faunal endemism across varied ecosystem types [9]. About five percent of the world's flora is represented in forest vegetation of the Philippines, composed of ferns and fern allies (pteridophytes), cone-bearing plants (gymnosperms) and angiosperms (flowering plants) that constitute around 22.5 % of the Malesian Region flora and 3.88 % of Earth's vascular plants [4].

One of the most promising genera in the Philippines with respect to ecological value is *Hoya*, an epiphytic genus in the family Apocynaceae, subfamily Asclepiadoideae [20]. It is a popular ornamental genus due to its waxy, succulent-type leaves and attractive flowers, geographically distributed from India to the Pacific Islands [22]. Worldwide, there are already at

least 500 published species names of *Hoya*, which represent approximately 350–450 species [18]. The Philippines is fortunate to be home to at least 202 species and 39 subspecies of *Hoya*, of which 197 are endemic [5].

The present study concerns the *Hoya* species thriving in the province of Batangas, Luzon Island. Batangas province has one of the fastest rates of land-use conversion in the Philippines [24], where massive development of road networks and lateral expansion of urban settlements to outlying rural districts have been ongoing during the last 30 years [3]. These aggressive developments may have potentially threatened the forest habitats where many *Hoya* taxa await discovery and need to be rescued into safe environments through various strategies such as *ex situ* conservation. Also, there has not been a single study conducted in the province of Batangas regarding the exploration of *Hoya* spp. in the natural habitats/ecosystems. The single study revealing the presence of *Hoya* in the province was the leaf analysis performed by Scott and Buot (2022) on *H. lacunosa* obtained from a *Hoya* collector's garden in Mabini, Batangas. Thus, there is still no formal record of any *Hoya* in the natural ecosystems of Batangas based on scientific publications and the database of Co's Digital Flora of the Philippines [16].

The present study, which can help to provide additional information on distribution records, pioneers the exploration of *Hoya* populations in the province of Batangas. The study also aims to identify the 'hosts' (substrates) of the individuals of this epiphytic organism and the associated flora that co-exists with *Hoya* within the ecosystem.

Methodology

2.1 Study site

The study was conducted in the municipality of Lobo, Batangas, from October 2019 to May 2020 (Figure 1). Lobo, a coastal municipality where the Verde Island Passage is located, is 148 km away from Metro Manila (capital of the Philippines) and 36 km from Batangas City (capital of Batangas province) and lies between 13°38'8"N latitude and 12°12'16"E longitude. It is situated on the southern part of Batangas and shares common boundaries with Taysan in the North, Verde Island Passage in the South, San Juan in the East and Batangas City in the West. The municipality has a total land area of 175.03 km² divided among 26 barangays (local administrative districts) with a human population of 40,736 as of 2020 [32]. The entire Lobo watershed receives low rainfall (30 mm) during dry months (November to April) and peak, 80 mm, during wet months (June to October), with temperatures ranging from 24°C to 31°C [31].

2.2 Survey, characterization, and identification of *Hoya* species and associated flora

A route-walk survey was employed to document the presence of *Hoya* species in Lobo, Batangas. The morphological characteristics, habitat (forest/ecosystem types where the *Hoya* plants were found), hosts, and locations (e.g. coordinates, elevation) of the individuals were observed and recorded in the field. The morphological features include the size, colour and appearance of the stems, leaves, internodes, petioles, and inflorescences. These characters were used as the basis for the identification of the species. Various literature and plant databases [2, 10, 11, 16, 19].

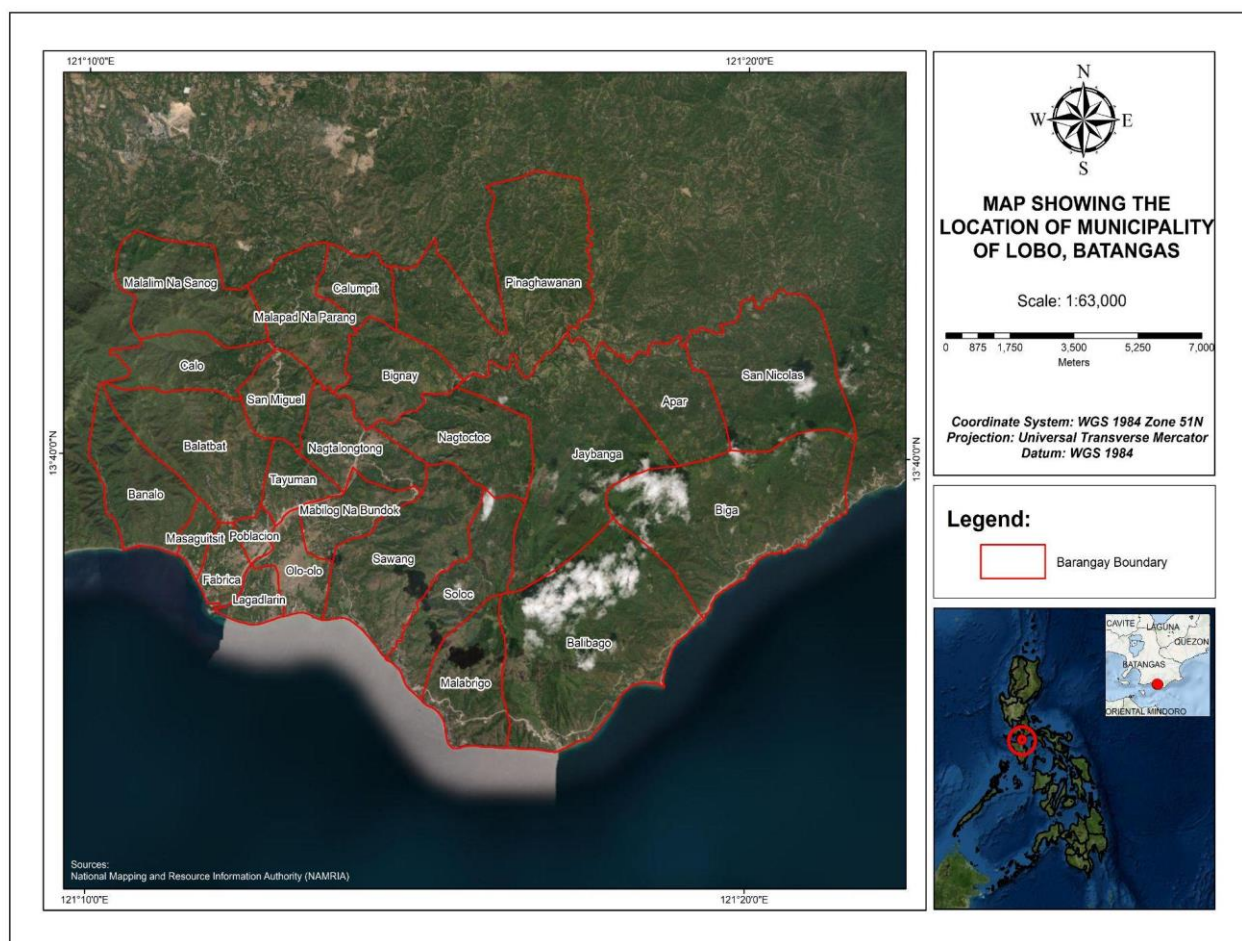


Fig. 1: Location map of the study site in Batangas province (Source: ESRI, 2022a, ArcGIS Online Basemap)

Other plant species within the habitat of *Hoya* sp. were also recorded. Only the associated flora within 5-metre distances from the documented *Hoya* plants was noted. The identification of the species was based on morphological characteristics and by use of references and databases of plant species in the Philippines such as Co's *Digital Flora of the Philippines* [16] and the *Kew Plant Database* [33]. Significant data including native status, endemism and conservation status were also gathered using local and international literature [16, 27, 30]. This was done to identify the species co-existing with *Hoya* individuals with an emphasis on their ecological and conservation values. This also helped to characterize the vegetation types and habitat of *Hoya*.

2.3 Data analysis

The data collected such as morphological characteristics and measurements of *Hoya* individuals were presented in tabular form against the existing literature. Individual counts of *Hoya* species were tabulated, and the associated flora was analyzed based on the frequency of observed cases. Moreover, some information about associated flora was used to determine the composition and the percentage of endemism, native status, and threatened plant species in the area.

Results

3.1 *Hoya* species in Lobo, Batangas

Only one species, *Hoya meliflua* (Blanco) Merr, was observed in Lobo, Batangas. Herbarium material was deposited in the Batangas State University – The National Engineering University Lobo Campus Herbarium with the registration number Pasado 001. The morphological characteristics of the individuals confirmed that this is indeed *H. meliflua*. The more detailed facts and information about this population of *H. meliflua* (i.e. morphological characteristics, geographical distribution, and ecology) are elaborated below.

3.1.1. Morphology of *Hoya meliflua* (Blanco) Merr. in Lobo, Batangas

The morphological characteristics of all 55 individual *H. meliflua* plants in Lobo were recorded and summarized to ensure the accuracy of the identification and that they belong to only one species. The material was then compared to the digital images available and the description in Rodda (2016). The presence of flowers in the climber specimen helped in conforming its identification. The habit, stem, internode, petiole, lamina, and inflorescence characteristics of the species observed in Lobo coincides with the description of Rodda (2016) (Table 1). Notable among these morphological features was its beautiful convex to globular inflorescence further characterized by the reflexed corolla and staminal white corona with a purple centre (Figure 2).

3.1.2. Geographical Distribution and Ecology of *Hoya* species in Lobo, Batangas

The individuals of *H. meliflua* were found to inhabit three barangays, namely Calumpit, Nagtoctoc, and Jaybanga. These individuals were found along the riverine secondary-growth forests with altitudes ranging from 100 to 300 m (Figure 3). In terms of abundance, most of the *H. meliflua* populations were observed in Calumpit with at least 30 individuals. Only few individuals were recorded from Nagtoctoc and Jaybanga, at least 15 and 10 individuals respectively.

The habitat ecology of *H. meliflua* revealed that it is a terrestrial or epiphytic plant. Some individuals were observed hanging on basaltic rock formations and on the ground growing in the soil substrate covered with forest litter. However, most individuals were observed to be climbers. Notable host species of *H. meliflua* included the Kalbang bamboo (*Schizostachyum textorium* (Blanco) Merr.), Balete (*Ficus balete* Merr.), Philippine Teak (*Tectona philippinensis* Benth. & Hook.f. ex Merr.), and Bayok (*Pterospermum diversifolium* Blume), among others. In Calumpit, the majority of the populations of *H. meliflua* were found in the clusters of *S. textorium*. The individuals of this bamboo are harvested and processed by the nearby communities and are exported to adjacent towns as trellises in tomato plantations. In Nagtoctoc, most of *H. meliflua* populations were seen in a famous natural ecotourism site, the *Tulay na Busog*, hanging on the branches of *T. philippinensis*. In Jaybanga, *H. meliflua* individuals were hanging on the large *P. diversifolium* trees located near the waterfalls of Sitio Bukal. During the search for *Hoya* species in Lobo, it was found that the local communities were not aware of these plants.

H. meliflua is known to occur as a native only in the Philippines and Borneo [33]. In the Philippines, the known and scientifically accepted populations were in the provinces of Apayao, Bataan, La Union, Laguna, Rizal, Leyte, Davao Oriental, Mindoro, Negros, Palawan, and Panay (Figure 4) [16]. It is also a nationally threatened species with Vulnerable status [27]. The province of Batangas is fortunate to host this important species. Moreover, it is the first record of any *Hoya* species in the province.

Table 1: Distinguishing features of *H. meliflua* based on the observed individuals in Lobo and the taxonomy of Rodda (2016)

Characters	<i>H. meliflua</i> in Lobo	<i>H. meliflua</i> by Rodda (2016)
Habit	Climber, at least 10 m long Terrestrial or epiphytic	Climber, 10m long or more Terrestrial or epiphytic
Stems	3–7 mm in diameter	(3–)5–8(–10) mm in diameter
Internode	10–23 cm long	10–20(–30) cm long
Petiole	2.5 cm x 5 mm	1–2.5 cm x 3–5 mm
Lamina	Oblong or elliptic, fleshy (succulent), 12.5–17 cm x 5–8, <i>apex</i> apiculate, <i>base</i> rounded, <i>margins</i> recurved, <i>venation</i> pinnate, <i>secondary veins</i> barely visible in live material, <i>tertiary venation</i> reticulate	Oblong or elliptic, fleshy, coriaceous when dry, (5)10–25(30) x 3–8 cm, <i>apex</i> acute or round (apiculate), <i>base</i> rounded (cuneate), <i>margins</i> recurved, <i>venation</i> pinnate, <i>secondary veins</i> barely visible in live material, <i>tertiary venation</i> reticulate
Inflorescences	Convex to globular 5–6 cm in diameter with 10 to 20 flowers	Convex to globular 4–6 cm in diameter with 5–20(–30) flowers
Peduncles	2–4 cm x 4–6 mm	(1–)3–7(–12) cm x 3–6 mm
Pedicels	2–2.3 cm x c. 1 mm	1.5–2.5cm x c. 1 mm
Corolla	Reflexed (bent backward), 17 mm to 19 mm when flattened, light pink to purple, pubescent inside and covered in maroon nectar, glabrous inside	Reflexed, 17–20 mm diameter when flattened, orange, light pink to purple, pubescent inside and covered in coloured (pink to maroon) nectar, glabrous outside
Corona	Staminal, white with a purple centre, fleshy, 6–8 mm in diameter	Staminal, white with a purple centre, fleshy, 6–8 mm in diameter
Corona lobes	Ovoid or rhomboid when observed from above, upper surface concave, with a hump in proximity with the outer lobe, inner process acuminate, outer process round to sub-acute	Ovoid or rhomboid when observed from above, upper surface concave, with a hump in proximity with the outer lobe, inner process acuminate, outer process round to sub-acute

3.2 Associated flora

The flora coexisting with *H. meliflua* was recorded and assessed. A total of 41 morpho-species of plants from 22 families were recorded (Calumpit = 29, Nagtactoc = 27, Jaybanga = 22) (Table 2). All species recorded were native to the Philippines, with 6 (14.63%) endemic to the country, and 8 (19.51%) had true threatened categories, excluding Least Concern (LC) of IUCN (Philippine Red List or DAO 2017 – 11 = 6, IUCN Red List = 3). The most notable among these species was the endemic *T. philippinensis* with an Endangered category both at a national [27] and international levels [30]. Social values were also associated, with some species such as *S. textorium* being utilized by the community for their livelihood.



Fig. 2: *H. meliflua* found in the forests of Nagtoctoc, Jaybanga, and Calumpit in Lobo, Batangas: (a) leaves collected from three locations, (b-d) flowers of *H. meliflua*; the nectar (the dark purple liquid formations on the base of the corolla) was shown in 2c

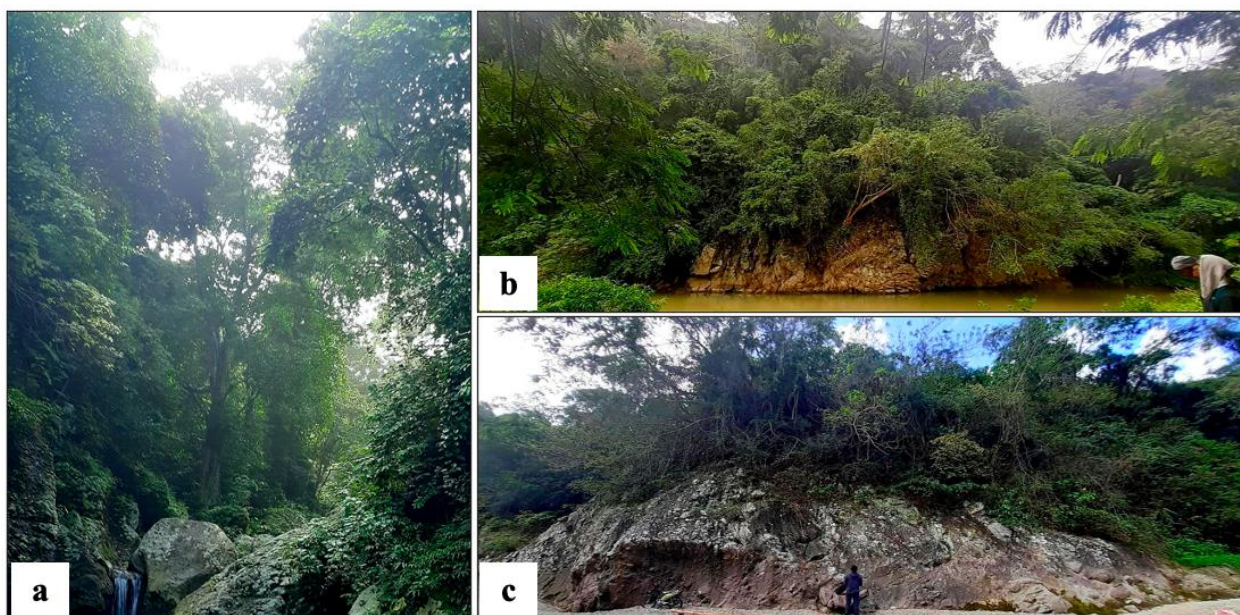


Fig. 3: Natural habitat of *H. meliflua* in Lobo, Batangas: a) Jaybanga, b) Calumpit, and c) Nagtoctoc

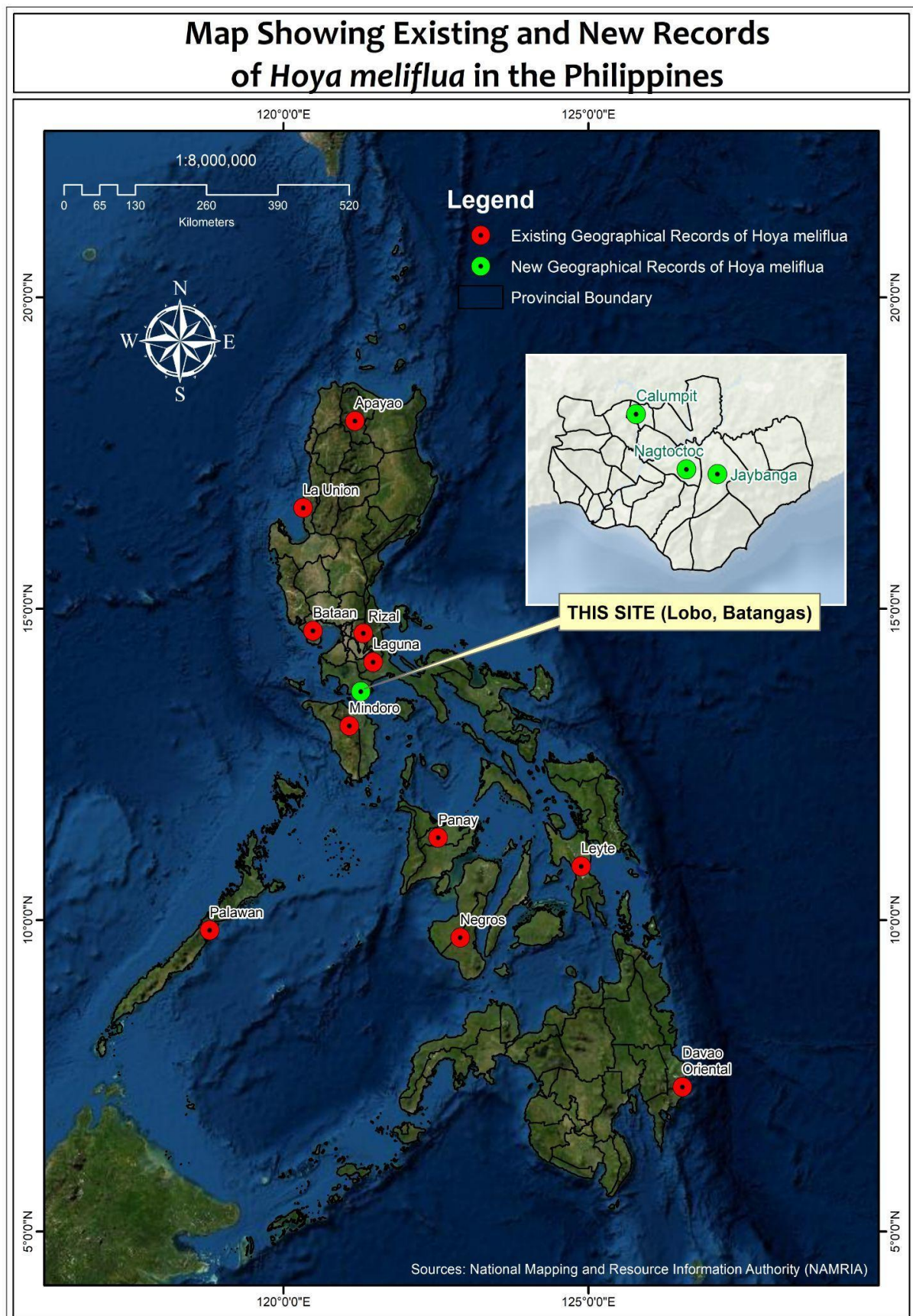


Fig. 4: Existing and new distribution records of *Hoya meliflua* (Blanco) Merr. in the Philippines (Source: ESRI, 2022b, ArcGIS Online Basemap)

Table 2: Associated flora within the habitats of *Hoya* species

Family	Species Name	Cal	Nag	Jay	Endemism	DAO 2017-11	IUCN Red List
Acanthaceae							
1	<i>Pseuderanthemum bicolor</i> (Schrank) Radlk.	–	+	–	NE	-	-
Anacardiaceae							
2	<i>Semecarpus cuneiformis</i> Blanco	+	+	+	NE	-	-
3	<i>Koordersiodendron pinnatum</i> (Blanco) Merr.	–	–	–	NE	OTS	-
4	<i>Buchanania microphylla</i> Engl.	+	–	+	NE	-	-
Apocynaceae							
5	<i>Wrightia pubescens</i> Roth.	+	–	+		-	LC
6	<i>Voacanga megacarpa</i> Merr.	+	+	+	E	-	VU
7	<i>Tabernaemontana pandacaqui</i> Poir.	+	+	–	NE	-	LC
8	<i>Alstoria scholaris</i> (L.) R.Br.	+	–	+	NE	-	LC
Araliaceae							
9	<i>Polyscias florosa</i> Philipson	–	–	+	E	-	EN
Burseraceae							
10	<i>Garuga floribunda</i> Decne.	+	+	+	NE	-	LC
Combretaceae							
11	<i>Terminalia polyantha</i> C. Presl.	–	+	–	NE	-	-
Ebenaceae							
12	<i>Diospyros pilosanthera</i> Blanco	+	+	–	NE	VU	-
Euphorbiaceae							
13	<i>Macaranga tanarius</i> (L.) Müll.Arg.	–	–	–	NE	-	LC
14	<i>Mallotus tiliifolius</i> (Blume) Müll.Arg.	+	+	+	NE	-	LC
15	<i>Mallotus mollissimus</i> (Geiseler) Airy Shaw	+	+	–	NE	-	LC
16	<i>Acalypha amentacea</i> Roxb.	+	+	+	NE	-	-
Poaceae							
17	<i>Schizostachyum textorium</i> (Blanco) Merr.	+	+	–	E	-	-
18	<i>Dinochloa acutiflora</i> (Munro) S.Dransf.	+	+	+	NE	OTS	-
Hypericaceae							
19	<i>Cratoxylum sumatranum</i> (Jack) Blume	+	+	+	NE	-	LC
Lamiaceae							
20	<i>Tectona philippinensis</i> Benth. & Hook.f. ex Merr.	–	+	–	E	EN	EN
Lauraceae							
21	<i>Cinnamomum mercadoi</i> S. Vidal	–	–	–	EN	OTS	LC
22	<i>Dehaasia incrassata</i> (Jack) Nees	–	+	–	NE	-	-
Leeaceae							
23	<i>Leea guineensis</i> G.Don	–	–	–	NE	-	-

Malvaceae							
24	<i>Berrya cordifolia</i> (Willd.) L.Laurent	+	–	+	NE	-	-
25	<i>Grewia multiflora</i> Juss.	+	+	+	NE	-	-
Moraceae							
26	<i>Ficus septica</i> Burm. f.	+	+	+	NE	-	LC
27	<i>Streblus asper</i> Lour.	+	+	–	NE	-	LC
28	<i>Ficus ampelas</i> Burm. f.	+	+	+	NE	-	LC
29	<i>Ficus balete</i> Merr.	+	+	+	E	-	LC
Myrtaceae							
30	<i>Syzygium calubcob</i> (C.B.Rob.) Merr.	+	–	+	NE	-	-
Palmae/Areaceae							
31	<i>Cocos nucifera</i> L.	–	–	+	NE	-	-
Rutaceae							
32	<i>Murraya paniculata</i> (Linn.) Jack	+	+	–	NE	-	-
33	<i>Trisphasia trifolia</i> (Burm.f.) P.Wilson	+	+	–	NE	-	-
Sapindaceae							
34	<i>Trigonachras cuspidata</i> Radlk.	+	+	+	E	-	-
35	<i>Tristira triptera</i> (Blanco) Radlk.	–	+	+	NE	-	-
Sterculiaceae							
36	<i>Kleinhovia hospita</i> L.	+	+	+	NE	-	LC
37	<i>Pterospermum diversifolium</i> Blume	+	–	–	NE	-	LC
38	<i>Sterculia foetida</i> L.	–	–	–	NE	-	-
Urticaceae							
39	<i>Dendrocnide meyeniana</i> (Walp.) Chew	+	+	–	NE	-	-
40	<i>Leucosyke capitellata</i> (Poir.) Wedd.	+	–	+	NE	-	LC
Verbenaceae							
41	<i>Vitex parviflora</i> Juss.	+	+	–	NE	EN	LC

Notes: Cal - Calumpit, Nag - Nagtactoc, Jay - Jaybanga, Bal - Balibago; A - Absent, P - Present; E - Endemic, NE - Non-endemic; OTS - Other Threatened Species, VU - Vulnerable, E - Endangered; LC - Least Concern

Discussion

Hoya plants are one of the most important local species in terms of ecological value with their many native, endemic and threatened taxa [1, 15, 20]. However, the threat to their natural habitat continues to proliferate, especially in the Philippines, despite being declared a biodiversity hotspot and a megadiversity country [25].

The new distribution record of *Hoya meliflua* in Batangas province is a significant step towards its conservation and habitat protection. Köhler et al. (2020) emphasized the critical importance of geographical range in species conservation whereby the expansion of the known distribution of a species can also expand the conservation efforts and strategies for it. Hence, being the first formally recognized record of *Hoya* species in the province of Batangas, plans and conservation efforts will definitely include this species as one of the priorities.

The geographical distribution and ecology of *H. meliflua* revealed its association with secondary riverine forests. This conforms with many other *Hoya* species recorded globally [8, 26]. Moreover, the hosts of *H. meliflua* in Lobo were relatively similar among sites; they include *T. philippinensis*, *S. textorium*, *P. diversifolium*, and *F. balete*. Its known hosts can be used as a guide in further searches and exploration of other *Hoya* species in the province with relatively similar vegetation and ecosystem types. This can help in revealing other *Hoya* species needing attention and conservation efforts.

Unfortunately, the populations of *H. meliflua* in Lobo constantly face threats due to human interventions. Harvesting the *S. textorium* bamboo, a host of *H. meliflua*, for livelihood purposes poses harm to the individuals of *H. meliflua*. Furthermore, the local communities had no idea about the existence and importance of these kinds of plants – alarming, since a species cannot be conserved if local people have no knowledge of it. Idohou et al. [7] highlighted that species are unlikely to be preserved if they are not actively mainstreamed in production and conservation policies. In the case of *H. meliflua* and any other *Hoya* species, their conservation could be better improved by introducing sustainable *in situ* conservation and *ex situ* production since these are already being utilized and marketed as ornamentals due to the attractive flowers [17]. The empowerment of local communities on their usage limit and management responsibilities is viewed as a significant factor in successful biodiversity conservation [13]. Also, the populations of *Hoya* plants in Lobo are found within ecotourism sites. This shall be maximized by using ecotourism as a tool in promoting the conservation of these species and mainstreaming them in tourists and nearby communities. Ecotourism is seen to be an effective tool in biodiversity conservation [21].

Besides the presence of *H. meliflua* in Lobo, the study also revealed a very high ecological importance of the area regarding floristic composition. There was a significant concentration of native, endemic, and threatened plant species within the habitat of *H. meliflua*. These species are key features in conserving biodiversity and natural habitat in an ecosystem to prevent species extinction and alien species invasion [6, 14]. Thus, conservation efforts are also necessary for these species as they comprise the habitat for *H. meliflua* in the area.

Conclusion

The expansion of the distribution record of *Hoya meliflua* in Batangas and its highly important habitats (including the native, endemic, and threatened associated flora) are vital in planning and implementing more effective conservation strategies. Furthermore, mainstreaming these important species through in-situ and ex-situ conservation and including them within ecotourism plans for educating tourists and local communities is vital in plant conservation. Future studies are encouraged to reveal other *Hoya* species in Batangas which can add information for better conservation of the species and its habitat.

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PRIMA MENȚIONARE A SPECIEI HOYA MELIFLUA (BLANCO) MERR. (APOCYNACEAE, ASCLEPIADOIDEAE) ÎN ECOSISTEMELE NATURALE DIN BATANGAS, INSULA LUZON, FILIPINE, CU NOTE ASUPRA FLOREI ASOCIATE

(Rezumat)

Insulele Filipine adăpostesc o concentrație relativ mare de specii native și endemice de *Hoya*. Cu toate acestea, genul *Hoya* nu a fost semnalat până în prezent în ecosistemele naturale din provincia Batangas, insula Luzon. Prezentul studiu este unul de pionierat în ceea ce privește explorarea speciilor de *Hoya* și a comunităților asociate acestora din Batangas. Pentru a înregistra speciile de *Hoya* din pădurile din Lobo, Batangas, s-a utilizat metoda traseelor. De-a lungul traseelor au fost notate și informații despre caracterele morfologice, habitat, planta gazdă, substrat și speciile de plante asociate. A fost identificată o singură specie, *Hoya meliflua* (Blanco) Merr., cu specimen depus la Herbarul Campusului Lobo al Universității Naționale de Inginerie (Reg. #: Pasado 001), Universitatea de Stat Batangas. Caracterele morfologice, precum și informații din alte referințe bibliografice și baze de date, au confirmat identitatea acesteia. S-a constatat că indivizii de *H. meliflua* din Lobo ocupă nișele din pădurile riverane secundare, de lângă siturile de ecoturism, împreună cu *Schizostachyum textorium* (Blanco) Merr., *Ficus balet* Merr., *Tectona philippinensis* Benth. & Hook.f. ex Merr. și *Pterospermum diversifolium* Blume, ca plante suport. Analiza florei însoțitoare a evidențiat prezența a 46 specii, toate native, dintre care 13% endemite din Filipine și 14% amenințate la nivel național și internațional. Conservarea speciei *H. meliflua* în Batangas poate fi îmbunătățită prin integrarea importanței sale ca plantă ornamentală și ca specie cheie în biodiversitate, în cadrul siturilor de ecoturism. Studiile ulterioare pot duce la identificarea altor specii de *Hoya* de pe insulă.