Vol. 2 December 2011
CHED Accredited Research Journal, Category A
Print ISSN 2094-5019 • Electronic ISSN 2244-0461
doi: http://dx.doi.org/10.7828/ajob.v2i1.90

Asian Journal of Biodiversity
Art. #90, pp. 1-13

Status of Plant Biodiversity in Mt. Malarayat, Batangas, Philippines

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Date Submitted: May 30, 2011
Final Revision Accepted: July 15, 2011

Abstract - The study determined the vegetative structure and assessed the current status of plant biodiversity in Mt. Malepunyo, one of its peaks. Herbarium of its floristic composition served as the baseline for future monitoring and scientific undertakings in the area. The quadrat technique was used to determine the vegetative structure and ecological dynamics of the forest of Mt. Malarayat- Malepunyo. The size of the quadrat was 100 square meters each (10x10 m). A total of 20 quadrats used were situated more or less along the trail to the peak. The study recorded a total of 104 species under 60 families; of which 46 species are indigenous or native to the Philippines; 27 species are introduced; 23 species endemic to Mt. Malarayat; and 9 species were unclassified. Eleven (11) were threatened species included in the conservation priority areas. The flora is composed of 67% trees, mostly from families Moraceae, Euphorbiaceae, Lauraceae, Meliaceae and Rubiaceae. The undergrowth layer includes shrubs (13%), vines (11%) herbs (5%) and ferns (4%). Its potential threats and anthropogenic disturbances include presence of invasive species, impacts of unregulated tourism activities, small scale timber poaching, hunting and land conversion.

Keywords - status, plant biodiversity, Mt. Malarayat, species richness

INTRODUCTION

Mount Malarayat, which was declared as a forest reserve in 1928 with watershed and timber production as it major functions, is noted to be the largest forest reserve in the Batangas province with an estimated area of 1,275 hectares. As a forest ecosystem, it provides environmental services including watershed, carbon sequestration, landscape beauty, and biodiversity conservation. It is the primary source of the water requirements of Lipa City and the low lying neighboring towns and is critical in the provision of water for the projected doubling of the population in the next twenty years. It still hosts a variety of native plants and animals that are endemic to the Philippines and some to Luzon.

Until the present time, however, the biodiversity of Mt. Malarayat, has been poorly explored. Despite the need for vegetation analyses and biomonitoring studies to better understand the ecosystem structure and processes, these works are rudimentary at best. It was in 1999 when the Babilonia-Wilner Foundation (now Pusod, Inc.) surveyed the mountain and found 71 species of land-based invertebrates. A biodiversity exploration study was conducted in Mt. Malarayat-Malepunyo to rapidly assess existing species of plants and animals in the area. There were122 plant species recorded in two study sites (i.e. Talisay Village and Sto.Niño Village). Out of the 122 plant species, 23 were found endemic.

De La Salle Lipa, has been actively participating in the many initiatives done to conserve and manage its watershed. As an academic partner, the proponents respond to one of the immediate needs to create a baseline data on plant biodiversity and asses its current status. This study presents preliminary information on the floristic composition, species diversity and dynamics on the different altitudinal zones and topographies of the mountain particularly at elevations of 100-900 m. This will serve as educational material and can be of use in long-term resource monitoring for the whole community and formulation of ordinances for local government unit, national awareness for its forest reserve as well as for global scenario on biodiversity.

OBJECTIVES OF THE STUDY

The study determined the diversity of plants in one of the peaks of Malarayat mountain range- Mt. Malepunyo.

Specifically, the study aimed to describe the vegetative structure of Mt. Malarayat- Malepunyo along the different elevations and topographies and determine the ecological dynamics in terms of species richness, evenness and diversity index.

MATERIALS AND METHODS

Study site

The site of this investigation is the Mt. Malepunyo, which is a part of the Malarayat ranges, located in the west side of Lipa City, Batangas province. It has an elevation of about 963 meters above sea level. The mountain also serves as watershed to Lipa City and its neighboring towns such as Malvar and Tanauan. Two villages located at the base of the mountain were used as entry points for trekking the mountain(i.e. Talisay Village and Sto. Niño Village). They are positioned at N13°58.476 E121°14.7" and N13°57.799' E121°13.501", respectively.

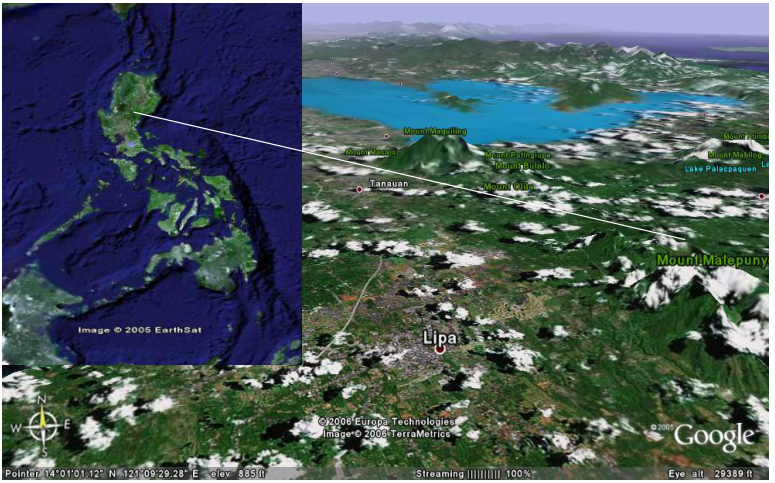

Fig. 1. Philippine map and landscape view of Lipa City showing Mt. Malenpuyo.

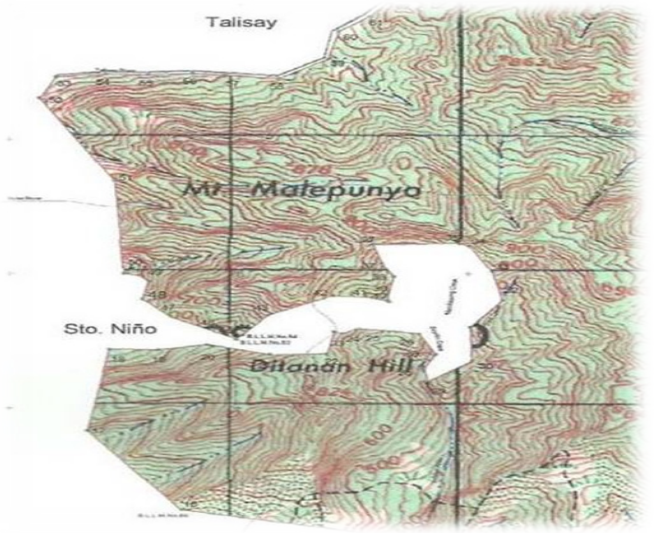

Fig. 2. The Mt. Malepunyo with Talisay village and Sto. Nino at its base.

The study was conducted using the vegetation along the trail of Sto. Nino village, a highly disturbed lowland forest but had a more rugged terrain with slopes ranging from moderately steep to very steep. Volcanic rocks and boulders are abundant and they constitute the main habitat. The soil is clayey but dry. Humus is shallow and the ground cover is largely made up of dry leaves. Two small creeks drain the area, these are Ilog Sala and Munting Ilog. The forest floor had a mix of fresh and very dry thick leaf litter cover of 2 – 3 cm.

Another trail used in the study is Talisay village. Just like Sto. Nino village, it is also a highly disturbed lowland forest with rolling terrain that had slopes ranging between 10-30 degrees. The soil is also clayey but dry. Humus is intermittent and very shallow while ground cover is dominated by dry leaves. The forest floor had a mix of fresh and very dry thick leaf litter cover of 5- 7 centimeters (cm). The sampling was done up until the station called Palamigan, with an elevation of 785 m and is situated at 13 57′ 91″ N latitude and 121 13′ 88″ E.

Mount Malarayat

Mt. Malarayat is one of the major features of the Southern Tagalog landscape, which also includes Mt. Makiling, the Mt. Banahaw complex, and Mt. Maculot. This mountain is cool, forested, and verdant for the most part, even the summit. Other areas are grassy, like those near Manabu Peak.

Its vastness gives rise to three destinations. The highest peaks of Mt. Malipunyo, Mt. Susong-Dalaga, and Manabu Peak. These three are interconnected through a separate itinerary exists for two hour trek to Manabu Peak. The customary trip is a traverse from Talisay in Lipa City. Atisan in San Pablo City. This trip entails a 3-4 hour climb, passing by woodlands and forested areas. A water source will be encountered an hour up, beyond which some parts would be steep, but with plenty of small trees to hold on to. The 4-5 hour descent north to San Pablo City involves the same trail for the first half, and then branch off to San Pablo after a grassy area.

Malepunyo actually has three peaks with almost identical elevations, with the summit (Peak 3) rising to 1005 MASL. In April 2008, the summit has been cleared of trees to become a viewdeck. A plaster statue of the crucifix has also been erected. In this viewdeck, and elsewhere in the summit, one can see Mt. Maculot, Taal Lake, Mt. Atimla, Mt. Kalisungan, the Banahaw complex, and Mt. Makiling. The two other peaks Susong Dalaga, and Manabu Peak are also visible (www.pinoymountaineer.com)

Another study entitled "Vertical distribution and zonation pattern of woody vegetation on the Northwestern slope of Mt. Mayon, Philippines" (Buot 2008) recorded 71 species belonging to 49 genera and 33 families by in three altitudinal zones determined by cluster and principal component analyses. It was also noted that dipterocarps were absent on the northwestern part of Mt. Mayon possibly due to volcanic eruptions and anthropogenic activities.

The PUSOD, Inc., an environmental non-government organization based in Lipa City and member of Lipa Head Waters Council, (LHWC) conducted another research expedition on Malarayat Watershed Reserve, this time to identify vulnerabilities of the said ecosystem and its dependent communities to climate change. The project, which was supported by the Philippine Tropical Forest Conservation Foundation

(PTFCF), consists of a biodiversity survey/assessment of existing flora and fauna, in particular to mammals, birds, herps and flowering plants. This rapid assessment of biodiversity recorded 16 species of mammals; 63 species of birds; 35 species of herps; and 122 plant species recorded in two study sites. A total of 89 species surveyed are endemic and this includes 7 out of 16 mammal species surveyed in the area; 35 out of 63 species of birds; 24 out of 35 species of herpetofauna; and 23 out of 122 plant species.

A study entitled "Vegetation Analysis of Angiosperm Flowering Plants at the Watershed of Mt. Malipunyo (Bulos and Paluay 2009) was conducted using a line transect method in a 5 by 100 meter grid. Plant species were identified accordingly Ilog Sala, Ilog Banaba, and Ilog Butas are the sites of the study. There are 82 species, 61 genera, and 39 families of angiosperm flowering plants found in these three sites. The top 5 species with the highest overall importance value are *Setaria plamifolia*, *Premna integrifolia*, Kulutong, *Ficus Septica*, and *Colocasia esculenta (L.) Schott*. The species with the highest overall importance value was *Setaria plamifolia* (19.5338), although Fabaceae dominates the watershed areas if the family is considered. Using Shannon-Weiner Index, Ilog Sala showed to have a greater diversity (3.57) than both Ilog Butas (3.23) and Ilog Banaba (3.13) despite having the lowest total number of plant species. Ilog Banaba showed the lowest angiosperm diversity (3.13) out of the three.

Scope and Limitation

The study covered the diversity of plants in the designated plots along the trail to one of the ranges of the Mt. Malarayat - Mt. Malepunyo and on the three tributaries of its watershed, namely, Ilog Sala, Munting Ilog, and Ilog Talisay. The survey and analysis were conducted from October to December 2010. It focused only on trees (overstorey) with diameter at breast height of at least 3 cm and a rapid assessment of the understorey vegetation seen in the study sites. Topography was also considered in site selection. The study likewise involved collection and handling of sample plants and development of an herbarium.

Reconnaissance surveys were conducted to establish the best sampling points, representing both the overstorey and understorey of the forest vegetation in the entire project site. Eight sampling sites were

identified from 200 m to 800 m altitude. The quadrat technique was used to determine the vegetative structure and ecological dynamics of the forest of Mt. Malarayat- Malepunyo. The size of the quadrat was 100 square meter each (10x10 m). A total of 20 quadrats used were situated more or less along the trail to the peak. Three quadrats per elevation or topography were taken, with an exception to elevation 341 m latitude, wherein only two quadrats were laid as vegetation was short, being near the NPC Tower 023. Identity of the species, their frequency and, diameter at breast height (DBH) of trees were determined. Likewise, the elevation (m) and the exposure (degree) were recorded in every sampling site. Sample specimens and photos of each unidentified plants were collected and taken. Unknown specimens were then identified at the herbarium of the National Museum, Manila, Philippines

Density, relative density, e, frequency, relative frequency, and species diversity index were computed after the data gathering.

Research Ethics

Research Ethics was observed by getting a gratuitous permit from the Department of Environment and Natural Resources to conducat the study in the sampling sites and permit from the leader of the indigenous people who live in the area.

RESULTS AND DISCUSSION

A. Overstorey

Of the seventy-one (71) species with minimum DBH of 3 cm, *Coffea sp.* had the highest density with 52 individuals. It comprised 13.08 % of the total density of 428 trees. Next are *Intsia bijuga* with 52 individuals and *Ficus septica* with 37 individuals and relative density of 12.15 % and 8.65 % respectively, implying that the three species mentioned are the most numerous among the species found within the area.

Among the 71 species measured in the 20 sampling points, *Coffea sp.* does not only hold the highest density value but also the highest frequency value. It has a relative frequency of 6%. *Ficus nota* had a relative frequency of 5% which is 1% higher than *Ficus septica's 4%. Artocarpus blancoi, Trema orientalis*, and *Intsia bijuga all have relative*

frequency of 3.5%. This suggests that *Coffea sp.* is the most widespread species in the forest of Mt. Malepunyo followed by %. *Ficus nota, Ficus septica's, Artocarpus blancoi, Trema orientalis,* and *Intsia bijuga.*

The diversity index, using Shannon's index, is 3.48. This value indicates that Mt. Malarayat- Malenpuyo has a diverse flora since it falls within the range of Shannon's index, which is between 1.5 and 3.5. Despite the low density it is diverse. This can be explained by the low dominance value per species observed in the area and large as it is not monopolized by a single or few species.

B. Understorey

There was a total of (34) undergrowth plant species belonging to (31) families recorded. This can be broken down into (4) ferns, (5) herbs, (14) shrubs, and (11) vines. Bamboos, pandan and cogon are moderately present in the area. It was also observed that moss is moderate to common in the site usually found in the tree. Canopy epiphytes were also present like pakong sundang, pakpak lawin, amlong, and kabalonga.

Table 1. Floristic composition of the understorey

Common Name	Family	Scientific Name
Herbs		
Takip Kohol	Apiaceae	*Centella asiatica* (L.) Urb
Biga	Araceae	*Alocasia macrorrhiza* (L.) Schott
Salibangon	Commelinaceae	*Pollia secundiflora* (Blume.) Bakh f.
Bat Flower	Taccaceae	*Tacca integrifolia* Kerr - Gawl.
Sili	Convolvulaceae	*Capsicum frutescens L*
Shrub		
Kasupangil	Lamiaceae	*Clerodendrum intermedium* Cham.
Bagang-aso	Annonaceae	*Anaxagorea luzoniensis* A. Gray
Bago	Gnetaceae	*Gnetum gnemon* Linn.
Taingang Babuy	Icacinaceae	*Gonocaryum calleryanum* (Baill.) Becc
Mali-mali	Leeaceae	*Leea guineensis* G. Don

Continuation of Table 1

Bamban	Marantaceae	*Donax canaeformis* (G. Forster) K. Schum
Is-is	Moraceae	*Ficus ulmifolia* Lamk.
Lunas	Rutaceae	*Lunasia amara* Blanco
Bagan-bagan	Solanaceae	Solanum biflorum Lour
Salagong Sibat	Thymeleaeceae	*Wikstroemia lanceolata* Merr.
Coronitas	Verbenaceae	*Lantana camara* Linn.
Hangor	Calliduloidea	*Achyranthes aspera* Linn.
Botonesan	Incurvarioidea	*Hyptis capitata* Jacq.
Mangkit	Malvaceae	*Urena Lobata* Linn.
Vine		
Amlong	Araceae	*Rhaphidophora merrillii* Engl.
Dugtong	Araceae	*Photos hermaphroditus* (Blanco) Merr.
Palasan	Arecaceae	*Calamus merrilli* Becc.
Sumulid	Arecaceae	*Daemonorops ochrolepis* Becc.
Kabalonga	Cucurbitaceae	*Trichosanthes tricuspidita* Lour.
Nami	Dioscoreaceae	*Dioscora hispida* Linn.
Agpoi	Papiloinoidae	*Bauhinia integrifolia* Roxb.
Jade Vine	Papiloinoidae	*Strongylodon macrobotrys* A. Gray
Albutra	Menispermaceae	*Arcangelisia flava* (L.) Merr.
Litlit	Piperaceae	*Piper sp.*
Nitong Puti	Shizaeaceae	*Lygodium circinnatum* (Burm. F.) Sw.
Fern		
Pakpak Lawin	Aspleniaceae	*Asplenium nidus* Linn.
Pakong Buwaya	Cyatheaceae	*Cyathea contaminans* (Wall. Et. Hook) Copel.
Salaguisog	Marattiaceae	*Angiopteris palmiformis* (Cav.) C. Chr.
Pakong Bato	Polypodiaceae	*Microsorum longissimum* Fee.

C. Forest Formation

The study sites at the Malarayat - Malepunyo mountain range in Lipa, Batangas have a secondary growth forest. Many emergent trees can be found in the study sites with height that ranges from 15-30 meters and a trunk with a diameter of 11 to 40 centimeters at breast height.

In the Proclamation No. 842- September 4, 1935, the forest type of Mt Malepunyo is mainly classified as a Forest Reserve, and further sub classified into Open forest and broadleaved. This holds true up to the present as it presents with broken tree layer covering at least 10% but less than 40% of the ground.

Forest formation is disturbed by natural catastrophic occurrences and anthropogenic inputs. Most of the species succeed after natural or man-made activities causing gaps and therefore interrupt the usual forest formation processes. Introduction of exotics like *Swietenia macrophylla* might have negative impacts to the native flora and fauna causing alteration of their natural habitats, in the future. However, the clearing of some vegetation in favor of the Coffee sp. is alarming.

The plant resources found inside the established plots consisted of 104 species and 60 families. The flora is composed of 67% trees, mostly from families *Moraceae, Euphorbiaceae, Lauraceae, Meliaceae* and Rubiaceae . The undergrowth layer includes shrubs (13%), vines (11%) herbs (5%) and ferns (4%).

D. Endemism and Conservation Status

Among the 105 species identified, 44% (46) of which are indigenous or native to the Philippines; 26% (27) are introduced or exotic; 22% (23) are species endemic to Mt. Malarayat; while 8% (9) species were unclassified. The list of which is in Appendix 1.

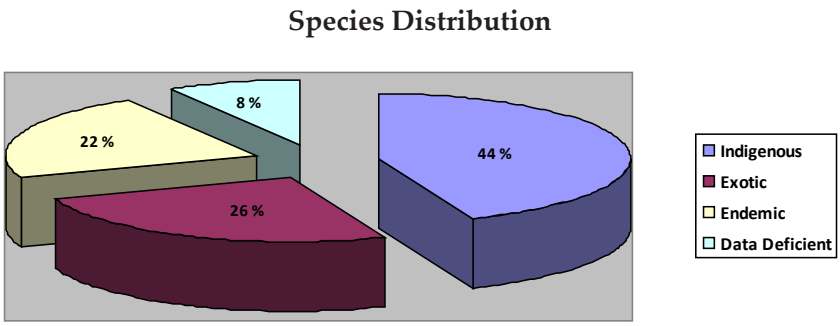

Fig. 3. Relative percentages of floral species of Mt. Malarayat- Malepunyo

Unfortunately, threatened species which are endemic to the country are also present in the area. Eleven species are under the International Union for the Conservation of Nature and Natural Resources (IUCN) "vulnerable" category. These are *Ficus ulmifolia, Celtiis luzonica, Terminalia pellucida, Dillenia philippinensis, Tristania decorticata, Cinnamomum mercadoi, Diplodiscus paniculatus, Artocarpus blancoi, Ziziphus talanai, Litsea glutinosa,* and *Ficus nota*. Some were declared as "low risk" which means that the species listed is not close to extinction. These species are *Alstonia macrophylla* and *Alstonia scholaris.*

E. THREATS

There is an evident improper utilization of both timber and non-timber forest products which may be due to lack of knowledge, skills and resources in the study sites. The presence of exotic and invasive plant species was also seen as a threat to the native vegetation and even faunal biodiversity. Mahogany for example has steep branches which do not permit the nesting of birds compared to the wide-spreading branches of other native trees. Timber poaching is still occurring in the area as a means to generate income according to some locals interviewed. In addition, hunters still continue to hunt them for subsistence. Hunting and timber poaching in Mt. Malarayat, although done in small scales, are an indication that the locals have insufficient information and awareness of the status of the biodiversity in their locality.

Another thing that poses threat in the area is the unregulated activities of the ecotourism such as trekking or mountain climbing. As campsites are developed and trails are made for accessibility of trekkers or climbers, further clearing of areas will take place.

Land conversion is another issue that threatens the biodiversity of Mt. Malarayat. This does not only refer to clearing of forest for coffee plantations but also pertains to the land utilization and construction of different establishments on privately owned parts of the mountain range.

CONCLUSIONS

The botanical expedition to Mt. Malarayat- Malepunyo recorded a total of 104 species under 60 families; of which 46 species are indigenous or native to the Philippines; 27 species are introduced; 23 species endemic to Mt. Malarayat; while 9 species were unclassified. Eleven (11) are found to be threatened species included in the conservation priority areas.

Analysis of data indicated that for the overstorey, of the seventy-one (70) species *Coffea sp.* had the highest density with 52 individuals comprising the comprised 13.08 % of the total density of 428 trees and subsequently the highest relative frequency of 6%. Diversity index for overstorey showed a value of 3.48 which indicates that it is relatively diverse.

For the understory, there was a total of 34 undergrowth plant species belonging to 31 families recorded. This can be broken down into ferns (4), herbs (5), shrubs (14), and vines (11).

Based on forest formation, it is a secondary forest, as threatened by anthropogenic inputs like improper extraction of forest products, introduction of invasive species, and land conversion

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