# TREE COMMUNITY ASSESSMENT IN A FOREST FRAGMENT IN SAN MATEO, RIZAL

**JOHN KEVIN S. CUISIA**

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College of Arts and Sciences
University of the Philippines – Manila
Padre Faura, Manila

**ENDORSEMENT**

The thesis attached hereto, entitled **Tree Community Assessment in a Forest Fragment in San Mateo, Rizal**, prepared and submitted by **John Kevin S. Cuisia**, in partial fulfillment of the requirements for the degree of Bachelor of Science in Biology was successfully defended on April 22, 2015.

**Elena M. Ragragio, MA**
Thesis Adviser

**Ralph Sedricke C. Lapuz, MS**
Thesis Co-Adviser

**Jasper John A. Obico, MS**
Thesis Reader

This undergraduate thesis is hereby officially accepted as partial fulfillment of the requirements for the degree of Bachelor of Science in Biology.

**Elena M. Ragragio, MA**
Chair
Department of Biology
UP Manila

**Leonardo R. Estacio, Jr., PHD**
Dean
College of Arts and Sciences
UP Manila

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**ABSTRACT**

The largest and most protected forest area in the Philippines is the Sierra Madre Mountain Range. It contains a large portion of Philippine forests and supports high plant diversity (Conservation International, 2014). In spite of this, the area is still considered as one of the most threatened areas due to anthropogenic activities that lead to deforestation and land conversions. Located in the foothills of San Mateo, Rizal, its proximity to developing rural areas has an impact to the diversity and classification of forest patches in the area. In this study, a tree community survey was done, to assess, classify and obtain the floristic composition of the tree community in this region. Plant lists were obtained and trees sampled were classified into either being native, non-native or exotic, endemic and if it occurs in primary growth or secondary growth forests. The results of the study concluded that the species *Ficus septica* is the most important species in the overall study site. Certain factors such as the elevation of the study site, the mode of seed dispersal and pollination, and presence of water heavily influenced the dominance of this species. Moreover, the study site was classified as a secondary growth forest, because majority of the species found in the area occurs in secondary growth forests, and also, disturbances and anthropogenic activities were observed on and near the area. Even though the site is a secondary forest, only 22.22% of the total species sampled were non – native, this implies that even if disturbances occurred in the area, non – native species are seldom introduced, that pioneer species were replaced by secondary growing species that is found locally. Understanding the floristic composition and nature of the area can be helpful in determining approaches in conservation efforts.

**Keywords:** Nature, Anthropogenic Activities, Sierra Madre Mountain Range, Floristic Composition

# CHAPTER I

# INTRODUCTION

## Background of the study

Forest and tree plantations sustain complex ecosystems that hold a large number of diverse living organisms. The alteration and conversion of forests for economic use can cause a major threat to its biodiversity, resulting in its decrease or loss among others. Furthermore, there is a continuous growth of secondary forests and agricultural lands that remodels forests, causing a significant decrease in areas containing primary forests (Wright *et al., 2005).* Replacement of these primary forests with secondary growth forests can be a clear indication that the area is being or has been disturbed, either by natural causes or human intervention. The Sierra Madre Mountain Range is the longest mountain range in the Philippines, holding 40% of the country's forest areas. It runs along the northern part of Luzon and it contains about 1.4 million hectares of tropical forest.

The mountain range supports hundreds of species and contains high plant diversity. Sierra Madre is also the foundation of the country's economy for it supplies water for hectares of plantations and provides energy that powers major cities of the Philippines, including Manila (Conservation International, 2014). In spite of the Sierra Madre mountain range being the largest protected area in the Philippines, it is still one of the most threatened areas due to deforestation and land conversions. Use of these lands for economic purposes threaten the native species in the area by introduction of non – native, invasive species because non – native species may displace native species by means of competition for resources or space. The introduction of these non – native species can be a real threat in elimination of native species, especially endemic ones

(IUCN, 2004). Although the area is still a part of the vast Sierra Madre mountain Range, they have been transformed into agricultural areas as well as for urban expansions. Many land changes have occurred that resulted to forests fragmentation in San Mateo, Rizal. These forest fragments are important areas for reforestation, as these can serve as refuges and sources of wildlings. Also, these foothills can give an insight on how forest ecosystems are affected when near urban development areas. It is in this light that a study of the tree community in San Mateo was conducted.

**Statement of the Problem:**

What are the characteristics of the tree community in the foothills of Sierra Madre, specifically, in San Mateo, Rizal?

**Research Objectives:**

Main Objective:

1. To characterize the tree community in Timberland, San Mateo, Rizal

Specific objectives:

1. To list tree species in the area of Timberland, San Mateo Rizal.
2. To determine the dominant and key species by computing for the importance value
3. To classify the forest fragment

**Significance of the Study:**

This study is conducted to assess the tree species community in the foothills of Sierra Madre, San Mateo, Rizal. With the knowledge of how the structure and nature of the tree community in the area is, we can be able to conclude whether the community is at risk from losing its endemic or native species, and if ever there are species that is vulnerable to extinction and should be protected. Effects on the tree composition can be observed due to the impact of land usage and conversion of forests. Insights from the study can be used to better understand the current situation of these forest fragments; these insights can be valuable in the formation of policies that can help the proper authorities conserve the area more efficiently. Plant inventory obtained from the study can be used to determine the potential rare and important species in the area. Study of these areas can be the key to effectively creating a wildlife corridor between fragmented forests to further allow exchange of species population which enhances the rehabilitation of areas. Also, the survey of the floristic composition of the area could be compared with already established studies in the Sierra Madre Mountain Range, and could elucidate how much urban development can affect the biodiversity of these forests and its floristic composition.

## Scope and Limitation

The tree community survey was conducted from September 6, 2014 to September 29, 2014 in the foothills of Sierra Madre, Timberland, San Mateo, Rizal and no other survey conducted on a different time line or season was done. Only three sites within the area were surveyed. During the survey, only trees with a diameter at base height (DBH) of 5 cm. or greater was included; and all those trees must be inside the 20 x 20 plot that was established by the proponents of the study.

The study is a descriptive type of research, as it will not include the history of the forest and no correlation between the trees surveyed and selected environmental factors were done. Biodiversity indices were not used in this study, as the study focused on the floristic composition and classifications of species.

## CHAPTER II

## REVIEW OF RELATED LITERATURE

***Timberland, San Mateo, Rizal***

Timberland Heights in San Mateo, Rizal is a 677-hectare property currently owned by Filinvest Corporation and is planned to be converted into an eco-entertainment zone. It is situated along the foot hill of Sierra Madre, a mountain range that holds key sites for biodiversity conservation. The Timberland Heights Agroforestry Center (AFC) is operated by The Institute of Agroforestry of the University of the Philippines Los Baños Foundation, Inc. (UPLBFI). AFC ensures to sustain productivity while maintaining the ecological stability of the place. An 80-hectare stretch of protected natural forest called Greenways is also maintained by the AFC. The said protected forest will be the site for further nature-based activites such mountain biking which currently being offered in Timberland (Agroforestry Center, 2010). Due to the area still being part of the Sierra Madre Mountain Range, and it being close to developing urban areas, it can be a great avenue for biodiversity studies that focus on how these factors influence the floristic composition and characteristics of forests.

***Sierra Madre mountain range, Philippines***

Sierra Madre mountain range in the Philippines has the largest old-growth tropical forest in the Philippines. According to Conservation International Philippines (2014), 1.4 million hectares of forest that includes areas of major production of economic goods like rice. Sierra Madre is situated along major parts of Luzon like Quezon and Isabela province. According to

FMB (2012), major provinces that constitute the Sierra Madre range are among the top ten provinces in terms of total area covered by forests. This includes Cagayan, Isabela Aurora, and Quezon province. Sierra Madre mountain range holds key biodiversity areas, namely Peñablanca Protected Landscape and Seascape, Quirino Protected Landscape, and Northern Sierra Madre National Park, that are now under protection. The Northern Sierra Madre National Park is the largest and most diverse protected area in the country it stretches along the terrestrial and coastal areas of Isabela. It is home for some endangered and threatened species like the *Shorea spp.* and *Hopea spp.,* which is a member of the Dipterocarp family (CI, 2014). The government inadvertently tolerates illegal logging in the area by being light handed in the implementation of logging policies, that they justify by calling it a livelihood for the majority of the people living near the park and that strict banning logging in the area can cause poverty. Annually, and estimated 20,00 to 35, 000 cu.m of wood is withdrawn from the park (Van der Ploeg *et al.,* 2011). Sierra Madre is the backbone of northern Luzon Island as it runs along 10 provinces, from Cagayan down to Quezon province. It supplies almost all of Luzon economic goods including their source of energy that powers neighboring cities.

***Philippine forests***

Tropical forests are known for having a rich and diverse ecosystem. The Philippines is one of the most and important biological hotspots in the world, yet the country still experience different kinds of environmental destructions. Human disturbances like *kaingin* or swidden agriculture and deforestation affect natural habitats and ecosystems, thus also influencing the biodiversity of an area. The Philippines is an archipelago consisting of 7, 107 islands and with a total land area of almost 30 million hectares. According to the Forest Management Bureau

(FMB, 2012), Philippine forest land, as of 2012, comprises 53% of the total land area of the Philippines. Of the total forest land in the Philippines 41% are different types of forest covers. Secondary forest ecosystems are the largest natural ecosystems in the Philippines (Lasco *et al., 2001*). With the same study by Lasco *et al.* (2001), it was stated that there are two known dominant type of secondary forest, the post extraction and swidden fallow secondary forests. Post extraction secondary forests involve human intervention like logging and land conversions for agricultural uses. This type of forest is the main source of wood products, thus it plays an important role in the economy of the country. The latter type involves the use of secondary forest by indigenous communities and tribes who obtain cultural and economic benefits from the forest. Swidden fallow type is less disturbed and interrupted compared to the post extraction secondary forest. With the current state of the Philippines, the continuous rehabilitation of Philippine forest is in progress under Department of Environment and Natural Resources' s (DENR) "General Program of Actions for the Forestry Sector from 2005-2010" (CIFOR, 2006).

***Tree community in Tropical forests***

Community is a group of different species (terrestrial or aquatic) that interacts with each other in a given area. Tree community describes the quantifiable structure of interacting tree species. The structure of a community can be characterized by the number of species with their relative abundance of each species. Different biodiversity indices can help predict the structure of a community. Many ecological processes contribute to the composition of species diversity that later describes what kind of tree community an area possess. Species composition of a forest often is associated with the state and nature of a community. Forests that show low growth rate for juveniles and survival rate cause a decline in the size distribution of a species. The presence of juvenile growth is strongly correlated to the size distribution of a tree population, thus indicating that size distribution does not necessarily indicate or predict future population trends. Size distribution only describes understory species and not for the canopy species. Slow-growing species tend to produce more juvenile in the understory (Condit *et al., 1998).*

Understory of three Asian tropical forests, compared to African and American forest, was predominantly composed of saplings of large canopy trees. African and American sites are more dominated by trees of smaller tress which are stature at maturity. Species endemic to Asian tropical forest contained larger classes of trees compared to that of the American and African forest. Tropical forests that appear to contain similar tree diversity and family of canopy trees differ in forest and ecological structure that may seem to impact the life of interacting organisms in the forest and regeneration of canopy trees (La Frankie *et al., 2006*).

Characteristics of lowland equatorial forests of Asia usually have upper canopy around 35 meters above the ground. The average diameter of the largest trees present in tropical forests have diameter ranging from one to 1.5 meter above the buttress and is about 40-50 meters tall. Listing 30 of the most common species of trees can show trees that are present in tropical Asian forests, most of these trees comprise only 1% of all the trees present. This fact shows how diverse are the trees of tropical Asia, wherein you may encounter hundreds of trees before you can meet any of the top 30 common trees. Ten of the most common species represent ten different families (Corlett, 2006). Dipterocarps dominate the basal area, covering about fifty percent, and also the canopy and understory of the tropical forest. Along with Dipterocarps, families such as Fabaceae, Malvaceae, and the Anacardiaceae - Burseraceae are among the most dominant species of trees in the forest. Seventy five percent of big trees that may be encountered may be classified in these families. These five families dominate the majority of dry-ground equatorial forests. Although some places vary, Moraceae is also known to be abundant in moisture-rich areas (Corlett, 2006). The presence of Lythraceae, specifically of the genera *Lagerstroemina,* becomes numerous in extreme dry seasons. Meanwhile, the most abundant and rich species of flowering trees are the Phyllanhaceae, Annonaceae and Rubiaceae (LaFrankie, 2010).

***Secondary and planted forests***

Forests and tree plantations sustain a complex ecosystem that holds numerous species such as birds, plants, and mammalian species. Tropical forests support at least two-thirds of the world's terrestrial ecosystem biodiversity. Humans also benefit from forests as it serves as source of some of the major economic goods. According to a study of Kareiva *et al.* (2007), only few remaining areas in the tropics have managed to stay undisturbed by human impacts and activities, making a large portion of forests affected by some form of human disturbances. Future extinction is feared when continuous illegal forests activities like deforestation, logging, and over conversion of forests areas will prevail. Although human impacts greatly influence the situation and condition of majority of the forests, environmental change and invasive species also play a role in the shaping of forests areas (Chadzon *et al*. 2006).

Ceaseless expansion of secondary forest only means that there is a decrease in the growth of primary forests. Primary tropical forests have a more complex and diverse ecosystem compared to secondary and planted forests (Carnus *et al.* 2006). Growth of the human population unknowingly depletes potential areas for vegetation and plantations, and human activity is the major cause of diminishing primary forests. In both tropics and temperate areas, part of potential forest cover is closely correlated with human population densities (Wright *et al.* 2005).

According to the same study by Wright *et al.* (2005), it is estimated that deforestation will decrease when there is an observed decline in human population. This allows a larger area for plantations and areas to be forested. Secondary forests seem to accumulate woody plant species at a much faster rate compared to mature forests but there is no clear pattern observed by the said phenomena. Secondary forests have a much simple forest structure with that of the mature forests. Compared to primary forests, which sustains a complex ecosystem, secondary and planted forests are much less diverse. According to Barlow *et al.* (2007), plant species richness increases from planted forests, secondary forests, and primary forests. The biodiversity of primary forests still is irreplaceable with that of the planted and regenerated areas.

Several qualities of forests recover upon disturbances often brought by natural calamities like hurricanes, forests fires and human interventions like logging and land conversions. But the rate of recovery varies based on the degree on which the area is subjected to a said disturbance. However, said disturbed areas are also affected by the interactions of local site factors, landscape profile, species diversity and species history (Chazdon *et al., 2006*). In a forest developing from a disturbance, new species begin to adapt and colonize. Over time, there is a gradual addition of new species thus forming a new community. Regenerating forest also rely on the nature of residual vegetation brought about by re-sprouting, remains of trees or shrubs, seedlings and saplings, and soil remnants. Many lowland tropical rainforests have short forests canopies, this is can be correlated with the occurrence of tropical cyclones that are usually present in tropical countries (De Gouvenain *et al.,* 2003). A complete understanding with regards of the forest vegetation change should incorporate not only major forests attributes but also the land configuration and conformation. Species analysis also helps in the analysis of the change in the vegetation of the forest due to disturbances and distractions. Recovery of disturbed forest usually takes a lot of time and a lot of ways to do it. In a study by Chazdon *et al.* (2003), he stated that re-sprouting of plant species is the most effective way a plant can recover from natural disturbances like forests fire. When subjected to extreme temperature, some plant species activate their dormant vegetative bud giving them the ability to regrow after forests fire. Some plants adapt to the disturbances in order to keep living. Successional processes often lead to different types of mature forests, usually not always the same as the forest itself after a major disturbance. The rate of vegetation change over successional forest is usually compared to adjacent mature and primary forests. According to Bremer *et al.* (2010), nearby primary forests have impact on the neighboring recovering forest or planted area by means of providing propagules that influences colonization a species to that particular area. Primary forests gradually shape secondary and recovering forest into the type of area it originally is.

## CHAPTER III

## METHODOLOGY

***Study site***

The study was done in the foothills of Sierra Madre, in Timberland, San Mateo, Rizal. The area is a property currently owned by Filinvest Corporation and is planned to be converted into an eco-recreational zone. This area is still part of the Sierra Madre Mountain Range, and also near developing urban areas.

***Sampling method***

Three sites were surveyed and selected, which were labeled Sites 1, 2, and 3. Below are the maps of each sampling site and for the GPS coordinates of the sampling area, refer to Table 2 of the appendix.

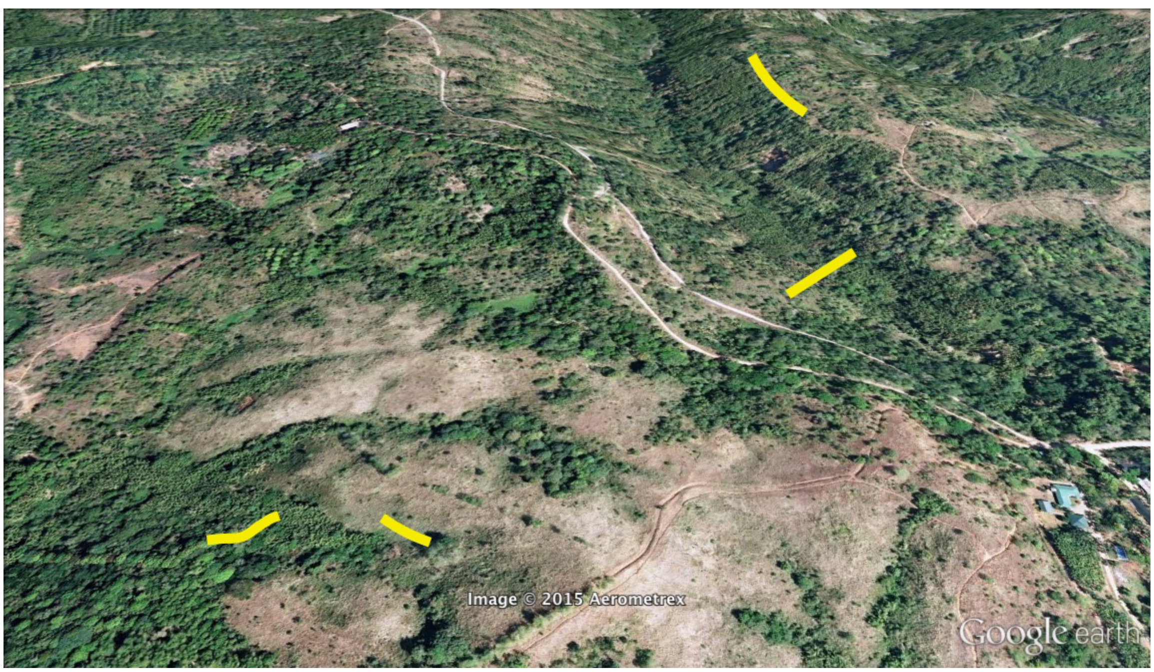


Figure 3.1 Map of Site 1 – Timberland, San Mateo, Rizal (Yellow lines represent transect lines)

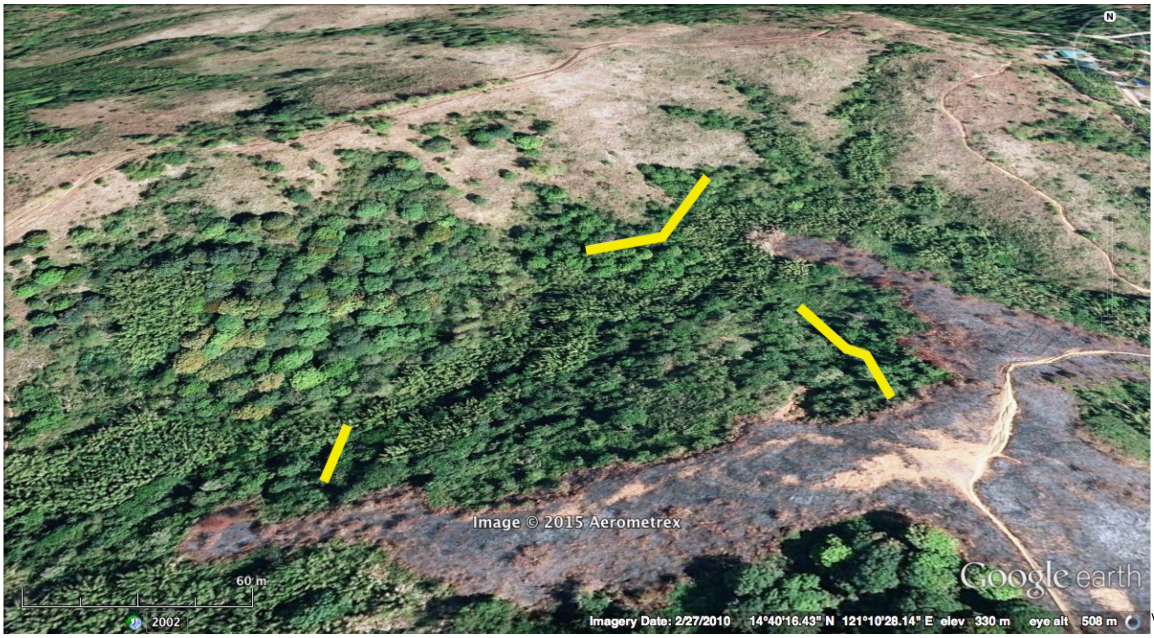

Figure 3.2 Map of Site 2 – Timberland, San Mateo, Rizal (Yellow lines represent transect lines)

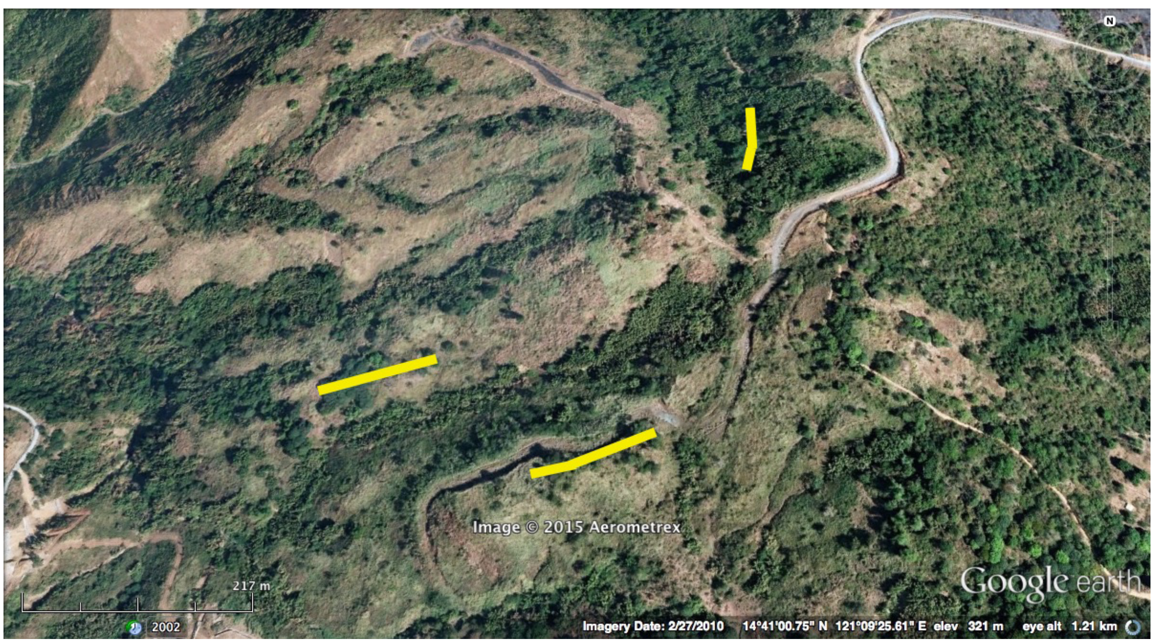

Figure 3.3 Map of Site 3 – Timberland, San Mateo, Rizal (Yellow lines represent transect lines)

Three transect lines were then established on every site; this was done by selecting a starting area then laying down a 100 meter transect line on which the points of the plot will be laid. But the length of each transect varied on each site, from 100 to 250 meters, depending on the accessibility of the area. On each transect, points were selected where 20m × 20m plots were established, with each plot having intervals ranging from 10 to 40 m. A total of 3 plots per transect were designated. In summary, a measurement of 300 m of transect per site were observed which consisted of three transects per site. A total of 900 meters were surveyed for the three sites. It is important to note that for site 1, the third transect line was bisected due to the presence of a river in the area.

***Collection of data and specimen***

In each plot, all trees with a diameter at breast height (DBH) of 5cm or greater was measured and included in the study. The DBH was set at 1.5 meters from the base of the tree; and using a diameter tape, the diameter of the tree was measured. Preliminary identification of the species surveyed was done on site, however, if the specimen was difficult to identify on site, samples of unidentified trees was obtained and brought to the laboratory. For unidentified tree species, parts of the tree like leaves, fruits, and flower, if available, were collected, wrapped in newspaper, stored inside Polyethylene Bags, and preserved in denatured alcohol. All collected plant parts were pressed and dried inside a herbarium oven. Herbarium specimens were then submitted to the Department of Botany in the National Museum for identification and verification of the collected taxa.

***Data analyses***

A table summarizing the occurrence of the tree species in each site was made. Information on the biogeographic origin of the species and whether the plant is found in primary or secondary forest was included in the table. Consultation with Leonard Co's Digital Flora website (philippineplants.org) provided information on the natural range of the species. Also, information on the conservation of each species was determined by looking at the red list of International Union for Conservation of Nature (IUCN).

# CHAPTER IV

# RESULTS

## Tree Species in Timberland, San Mateo, Rizal

A total of 559 tree individuals classified into 62 species were recorded in the 27 20x20 m study plots in the foothills of Sierra Madre, Timberland San Mateo Rizal. Table 1 shows the tree species, together with their respective families and biogeographic natures.

Table 4.1. List of all tree species in the study site with corresponding families, and biogeographic nature

| Tree Species | Local Name | Family | Biogeographic Nature |
|---|---|---|---|
| *Albizia procera* | Akle | Fabaceae | Native |
| *Albizia sp.* | Malatuko | Fabaceae | - |
| *Antidesma bunius* | Bignay | Phyllantacea | Native |
| *Antidesma ghaesembilla* | Binayuyo | Phyllantacea | Native |
| *Arthrophyllum ahernianum* | - | Araliaceae | Native |
| *Artocarpus blancoi* | Antipolo | Moraceae | Native/Endemic |
| *Artocarpus heterophyllus* | Langka | Moracea | Non Native |
| *Artocarpus odoratissimus* | Marang | Moraceae | Native |
| *Bauhinia malabarica* | Alibangbang | Fabaceae | Native |
| *Bombax ceiba* | Malabulak | Malvaceae | Native |
| *Breynia cernua* | - | Phyllantacea | Native |
| *Buchanania arborescens* | Blume | Anacardiaceae | Native |
| *Canarium asperum* | Pili | Burseraceae | Native |
| *Canarium hirsutum* | - | Burseraceae | Native |
| *Chrysophyllum cainito* | Caimito | Sapotaceae | Non Native |
| *Coffea sp.* | Kape | Rubiaceae | Non Native |
| *Commersonia bartramia* | - | Malvaceae | Non Native |
| *Cordia dichotoma* | - | Boraginaceae | Native |
| *Dioxylum indicum* | - | Bignoniaceae | Native |
| *Eucalyptus sp.* | Eucalyptus | Myrtaceae | Non Native |
| *Ficus minahassae* | Hagimit | Moraceae | Native |
| *Ficus nota* | Tibig | Moraceae | Native |
| *Ficus pseudopalma* | Lubi - Lubi | Moraceae | Native/Endemic |
| *Ficus septica* | Tibig Puti | Moraceae | Non Native |
| *Ficus ulmifolia* | Is-is | Moraceae | Native |

| | | | |
|---|---|---|---|
| Ficus variegate | Tibig pula | Moraceae | Non Native |
| *Gliricidia sp.* | Kakawati | Fabaceae | Non Native |
| *Glochidion album* | - | Phyllantaceae | Native/Endemic |
| *Glochidion cuminii* | | Phyllantaceae | Native |
| *Gmelina arborea* | Gmelina | Lamiaceae | Non Native |
| *Gmelina sp.* | Gmelina | Lamiaceae | Non Native |
| *Grewia laevigata* | | Malvaceae | Native |
| *Guioa koelreutaria* | Anayen | Sapindaceae | Native/Endemic |
| *Lagerstromia speciosa* | Banaba | Lythraceae | Native |
| *Leea guineensis* | - | Vitaceae | Native/Endemic |
| *Lepisanthes fruticosa* | - | Sapindaceae | Non Native |
| *Leucaena leucocephala* | Ipil - Ipil | Fabaceae | Non Native |
| *Leucocyke capitellata* | - | Euphorbiaceae | Native |
| *Litsea cordata* | - | Lauraceae | Native |
| *Litsea glutinosa* | Mala Puso | Lauraceae | Native |
| *Macaranga tanarius* | Binunga | Euphorbiaceae | Native |
| *Mangifera indica* | Mangga | Anacardiaceae | Non Native |
| *Melicope triphylla* | Botong | Rutaceae | Native/Endemic |
| *Mitragyna speciosa* | Mambog | Rubiaceae | Native |
| *Mussaenda philippica* | Kahoy dalaga | Rubiaceae | Native |
| *Nephelium lappaceum* | Rambutan | Sapindaceae | Non Native |
| *Parkia timoriana* | Cupang | Fabaceae | Native |
| *Persea americana* | Avocado | Lauraceae | Non Native |
| *Pipturus asper* | - | Urticaceae | Native |
| *Pittosporum pentandrum* | - | Pittosporaceae | Native |
| *Premna odorata* | Alagaw | Lamiaceae | Native |
| *Psidium guajava* | Bayabas | Myrtaceae | Non Native |
| *Pterocarpus indicus* | Narra | Fabaceae | Native |
| *Sandoricum koetjape* | Santol | Meliaceae | Non Native |
| *Semecarpus cuneiformis* | Ligas | Anacardiaceae | Native/Endemic |
| *Semecarpus sp.* | | Anacardiaceae | - |
| *Syzygium cumini* | Duhat | Myrtaceae | Non Native |
| *Syzygium sp.* | - | Myrtaceae | - |
| *Vitex negundo* | Lagundi | Lamiaceae | Native |
| *Vitex parviflora* | Molave | Lamiaceae | Native |
| *Rubia wendlandia* | - | Rubiaceae | Native/Endemic |
| *Wrightia laevis* | Lanete | Apocynaceae | Native |

The identified species belong to 23 families. Family Moraceae contains the highest number of species (*Artocarpus blancoi, Artocarpus heterophyllus, Artocarpus odoratissimus,* *Ficus minahassae, Ficus nota, Ficus pseudopalma, Ficus septica, Ficus ulmifolia,* and *Ficus variegata*). Out of 62 species, 14 species are non – native species. These have been considered part of naturalized populations because it has been introduced to our country a long time ago. Four species are considered vulnerable. These are *Artocarpus blancoi*, *Ficus ulmifolia*, *Pterocarpus indicus* and *Vitex parviflora*

**Tree Diversity in Site 1**

There was a total of 179 individuals classified into 27 species found within the nine plots in the first site of the foothills of Sierra Madre, Timberland, San Mateo Rizal. Identified species belong to 17 families wherein the family Moraceae contain the highest number of representative species (*A. blancoi, A. heterophyllus, F. nota, F. septica,* and *F. nota, M. tanarius*)

Table 4.2. Families in the floristic composition of the Site 1 in the foothills of Sierra Madre, Timberland, San Mateo Rizal in terms of species abundance in percentage

| Families | Number of species per Family | Total number of individuals | Overall Percentage |
|---|---|---|---|
| Moraceae | 5 | 75 | 41.90 |
| Fabaceae | 5 | 66 | 36.87 |
| Lauraceae | 2 | 6 | 3.35 |
| Rubiaceae | 1 | 5 | 2.79 |
| Meliaceae | 1 | 5 | 2.79 |
| Anacardiaceae | 1 | 4 | 2.23 |
| Sapindaceae | 1 | 3 | 1.67 |
| Apocynaceae | 1 | 3 | 1.67 |
| Phyllantaceae | 2 | 2 | 1.11 |
| Euphorbiaceae | 1 | 2 | 1.11 |
| Myrtaceae | 1 | 2 | 1.11 |
| Malvaceae | 1 | 1 | 0.55 |

| | | | |
|---|---|---|---|
| Bursaceae | 1 | 1 | 0.55 |
| Sapotaceae | 1 | 1 | 0.55 |
| Boraginaceae | 1 | 1 | 0.55 |
| Bignoniaceae | 1 | 1 | 0.55 |
| Lamiaceae | 1 | 1 | 0.55 |

Table 2 shows that the family that the family Moraceae constitutes 41.90% of the tree population in site one. It is followed by the family Fabaceae making up 36.87% of the whole tree population for site one. *Leucaena leucocephala* is the species with the highest number of individuals with 39 followed by *F. septica* with 36 individuals and both species are under the family Moraceae.

Table 4.3. List of top ten most important species of site one of the foothills of Sierra Madre, Timberland, San Mateo Rizal.

| Tree Species | Relative Density | Relative Dominance | Relative Frequency | Importance Value |
|---|---|---|---|---|
| *Bombax ceiba* | 0.56 | **55.37** | 1.43 | **57.36** |
| *Ficus septica* | 20.11 | 0.74 | **12.86** | 33.71 |
| *Leucaena leucocephala* | **21.79** | 1.55 | 5.71 | 29.05 |
| *Ficus nota* | 15.64 | 1.21 | 10.00 | 26.85 |
| *Albizia procera* | 5.59 | 6.06 | 4.29 | 15.93 |
| *Gliricidia sp.* | 8.38 | 0.38 | 7.14 | 15.91 |
| *Mangifera indica* | 2.24 | 5.89 | 4.29 | 12.41 |
| *Artocarpus heterophyllus* | 2.79 | 1.10 | 7.14 | 11.04 |
| *Sandoricum koetjape* | 2.79 | 0.49 | 5.71 | 9.00 |
| *Artocarpus blancoi* | 2.79 | 0.27 | 5.71 | 8.77 |

*Leucaena leucocephala* has a density of 0.11 per square meter, which is the highest density for all species for site one. It is followed by *Ficus septica* with a density of 0.1 per square meter. The most frequent species are *F. septica, Gliricidia sp., A. heterophyllus, L. leucocephala,* *S. keotjape,* and *A. blancoi. Bombax ceiba* is the most dominant and also the most important species for site one. Table 3 shows the importance value of the top ten species present in the site one of the study site.

**Tree Diversity in Site Two**

A total of 259 individuals classified into 42 species are found within the nine 20x20 m plots in the second site of the foothills of Sierra Madre, Timberland, San Mateo, Rizal. Identified species belong to 18 families wherein the family Moraceae contains the highest number of individuals under 8 species (*A. blancoi, A. heterophyllus, A. odoratissimus, F. nota, F. pseudopalma, F. septica, F. ulmifolia,* and *F. variegata*).

Table 4.4. Families in the floristic composition of site two in the foothills of Sierra Madre, Timberland, San Mateo Rizal in terms of species abundance in percentage.

| Families | Number of species per Family | Total number of individuals | Overall Percentage |
|---|---|---|---|
| Moraceae | 8 | 100 | 38.61 |
| Meliaceae | 1 | 39 | 15.06 |
| Euphorbiaceae | 2 | 38 | 14.67 |
| Fabaceae | 5 | 14 | 5.40 |
| Apocynaceae | 1 | 13 | 5.01 |
| Anacardiaceae | 4 | 9 | 3.47 |
| Lauraceae | 3 | 8 | 3.08 |
| Rubiaceae | 3 | 8 | 3.08 |
| Rutaceae | 1 | 8 | 3.08 |
| Sapindaceae | 3 | 7 | 2.70 |
| Phyllantaceae | 3 | 6 | 2.31 |
| Malvaceae | 2 | 2 | 0.77 |
| Sapotaceae | 1 | 2 | 0.72 |

| | | | |
|---|---|---|---|
| Burseraceae | 1 | 1 | 0.38 |
| Lamiaceae | 1 | 1 | 0.38 |
| Lythraceae | 1 | 1 | 0.38 |
| Pittosporaceae | 1 | 1 | 0.38 |
| Vitaceae | 1 | 1 | 0.38 |

Family Moraceae makes up 38.61% of the tree population for site two, containing 100 individuals under 8 species. It is followed by the family Meliaceae with 15.06% of the population for site two. *F. nota* and *M. tanaraius* contain the highest number of tree individuals with 35 each, belonging to the family Moraceae and Euphorbiaceae respectively.

Table 4.5. List of top ten most important species for Site Two of the foothills of Sierra Madre Timberland, San Mateo Rizal.

| Tree Species | Relative Density | Relative Dominance | Relative Frequency | Importance Value |
|---|---|---|---|---|
| *Sandoricum koetjape* | **15.23** | 5.26 | 6.86 | **27.36** |
| *Ficus nota* | 13.67 | 2.80 | **8.82** | 25.30 |
| *Macaranga tanarius* | 13.67 | 0.80 | 5.88 | 20.35 |
| *Artocarpus odoratissimus* | 0.39 | **18.91** | 0.98 | 20.28 |
| *Ficus septica* | 8.98 | 1.67 | 6.86 | 17.52 |
| *Artocarpus heterophyllus* | 8.20 | 2.03 | 3.92 | 14.15 |
| *Leucaena leucocephala* | 0.39 | 12.18 | 0.98 | 13.55 |
| *Artocarpus blancoi* | 5.86 | 2.03 | 4.90 | 12.79 |
| *Albizia procera* | 0.39 | 8.18 | 0.98 | 9.55 |
| *Wrightia laevis* | 5.08 | 1.40 | 2.94 | 9.42 |

*Sandoricum koetjape* has the highest density for site two with 0.12 per square meter. It is then followed by *F. nota* and *M. tanarius* with a density of 0.09 per square meter. The most frequent species are *F. nota, F. septica, S. koetjape, M. tanarius,* and *A. blancoi.* On the other hand, the most dominant species is *A. odoratissimus,* followed by *L. leucocephala.* The most important species for site two would be *S. koetjape* as shown in Table 5.

**Tree Diversity in Site Three**

A total of 121 tree individuals classified into 28 species were recorded in the nine 20x20 m plots established along the foothills of Sierra Madre, Timberland, San Mateo Rizal. Identified species are classified into 15 families where the family Moraceae contains the highest number of representative species (*Ficus minahassae, Ficus nota, Fiucs pseudopalma,* and *Ficus septica*).

Table 4.6. Families in the floristic composition of Site 3 in the foothills of Sierra Madre, Timberland, San Mateo Rizal in terms of species abundance in percentage.

| Families | Number of species per Family | Total number of individuals | Overall Percentage |
|---|---|---|---|
| Moraceae | 5 | 40 | 33.06 |
| Fabaceae | 4 | 17 | 14.05 |
| Euphorbiaceae | 1 | 16 | 13.22 |
| Lamiaceae | 4 | 13 | 10.74 |
| Phyllantaceae | 1 | 11 | 9.09 |
| Myrtaceae | 4 | 7 | 5.78 |
| Anacardiaceae | 1 | 6 | 4.95 |
| Lythraceae | 1 | 3 | 2.47 |
| Malvaceae | 1 | 2 | 1.65 |
| Apocynaceae | 1 | 1 | 0.82 |
| Araliaceae | 1 | 1 | 0.82 |
| Lauraceae | 1 | 1 | 0.82 |
| Meliaceae | 1 | 1 | 0.82 |
| Rubiaceae | 1 | 1 | 0.82 |
| Urticaceae | 1 | 1 | 0.82 |

It is shown in Table 6 that the family Moraceae constitutes 33.06% of the whole tree population for the third site, followed by Fabaceae with 14.05% of the tree population. The species containing the highest number of individuals is *F. septica* with 24 individuals followed by *M. tanarius* with 16 individuals, coming from the families Moraceae and Euphorbiaceae respectively.

Table 4.7. List of top ten most important species for Site Three of the foothills of Sierra Madre Timberland, San Mateo Rizal.

| Tree Species | Relative Density | Relative Dominance | Relative Frequency | Importance Value |
|---|---|---|---|---|
| *Mangifera indica* | 5.04 | **29.73** | 5.26 | **40.03** |
| *Ficus septica* | **20.17** | 0.51 | **12.28** | 32.95 |
| *Ficus minahassae* | 0.84 | 29.17 | 1.75 | 31.76 |
| *Macaranga tanarius* | 13.44 | 0.82 | **12.28** | 26.54 |
| *Albizia procera* | 10.08 | 2.75 | 7.02 | 19.85 |
| *Gmelina arborea* | 2.52 | 14.68 | 1.75 | 18.96 |
| *Gmelina sp.* | 5.04 | 10.02 | 3.51 | 18.56 |
| *Ficus nota* | 8.40 | 1.71 | 7.02 | 17.13 |
| *Antidesma ghaesembilla* | 9.24 | 0.87 | 5.26 | 15.38 |
| *Syzigium cuminii* | 0.84 | 10.50 | 1.75 | 13.10 |

*Ficus septica* has the highest density with 0.067 per square meter, followed by *M. tanarius* with 0.044 per square meter. Both species are also the most frequent species for site three. *M. indica* and *F. minahassae* are the two most dominant species followed by *Gmelina arborea* and *Gmelina sp.* The most important species for the third site is *M. indica.* Table 7 shows the computed importance values of the top ten species for the third site.

**Tree Diversity in the Overall Site**

Table 4.8. Families in the floristic composition in the foothills of Sierra Madre, Timberland, San Mateo Rizal in terms of species abundance in percentage.

| Families | Number of species per Family | Total number of individuals | Overall Percentage |
|---|---|---|---|
| Moraceae | 9 | 215 | 38.46 |
| Fabaceae | 7 | 61 | 10.91 |
| Euphorbiaceae | 2 | 106 | 18.96 |
| Meliaceae | 1 | 45 | 8.05 |
| Phyllantaceae | 5 | 58 | 10.37 |
| Anacardiacea | 4 | 19 | 3.39 |
| Apocynaceae | 1 | 17 | 3.04 |
| Lamiaceae | 5 | 54 | 9.66 |
| Lauraceae | 3 | 15 | 2.68 |
| Rubiaceae | 4 | 23 | 4.11 |
| Sapindaceae | 3 | 15 | 2.68 |
| Myrtaceae | 4 | 9 | 1.61 |
| Rutaceae | 1 | 8 | 1.43 |
| Malvaceae | 3 | 55 | 9.83 |
| Lythraceae | 1 | 4 | 0.71 |
| Sapotaceae | 1 | 3 | 0.53 |
| Burseraceae | 2 | 2 | 0.35 |
| Araliaceae | 1 | 1 | 0.17 |
| Boraginaceae | 1 | 1 | 0.17 |
| Bignoniaceae | 1 | 1 | 0.17 |
| Vitaceae | 1 | 1 | 0.17 |
| Urticeae | 1 | 1 | 0.17 |
| Pittosporacea | 1 | 1 | 0.17 |

It is shown in Table 8 that the family Moraceae makes up 38.46% of the whole tree population in the overall site, containing the most number of individual species. It is followed by the family Fabaceae which comprises 17.35% of the total population. The species with the species with the highest number of individuals is *Ficus septica* with 83 individuals followed by *Ficus nota* with 73 individuals, both from the family Moraceae.

Table 4.9. List of top ten most important species for the overall site in the foothills of Sierra Madre, Timberland, San Mateo Rizal.

| Tree Species | Relative Density | Relative Dominance | Relative Frequency | Importance Value |
|---|---|---|---|---|
| *Ficus septica* | **14.85** | 0.45 | **10.13** | **25.43** |
| *Ficus nota* | 13.06 | 0.88 | 8.81 | 22.75 |
| *Ficus minahassae* | 0.18 | **17.15** | 0.44 | 17.77 |
| *Macaranga tanarius* | 9.48 | 0.38 | 6.61 | 16.47 |
| *Sandoricum koetjape* | 8.05 | 1.34 | 5.29 | 14.68 |
| *Mangifera indica* | 2.33 | 7.21 | 3.52 | 13.06 |
| *Leucaena leucocephala* | 7.16 | 1.18 | 2.20 | 10.53 |
| *Albizia procera* | 4.11 | 2.70 | 3.52 | 10.34 |
| *Artocarpus blancoi* | 4.29 | 0.64 | 5.29 | 10.22 |
| *Gmelina arborea* | 0.54 | 8.64 | 0.44 | 9.61 |

The species with the highest density and most frequent is *Ficus septica,* while the most dominant species is the *Gmelina arborea.* In terms of density, *Ficus septica, Ficus nota, Macaranga tanarius, Sandoricum koetjape, and Leucaena leucocephala* were the trees with the highest values. The five most dominant species in the area were *Ficus minahassae, Gmelina arborea, Bombax ceiba, Mangifera indica, and Syzygium sp* while the most frequent trees in the whole study sites were *F. septica, F. nota, M. tanarius, Artocarpus blancoi,* and *S. koetjape.* Importance values computed for the top ten species in the overall site are shown in Table 9.

Table 4.10. List of all Vulnerable species according to the IUCN

| Species name | Common name | Status |
|---|---|---|
| *Artocarpus blancoi* | Antipolo | VU |
| *Ficus ulmifolia* | Is-is | VU |
| *Pterocarpus indicus* | Narra | VU |
| *Vitex parviflora* | Molave | VU |

Only four species from all the selection have been found to be on a vulnerable state. They are *Artocarpus blancoi*, *Ficus ulmifolia*, *Pterocarpus indicus* and *Vitex parviflora*. The rest of the species included in the survey have a status of "Least Concerned".

# CHAPTER V

# DISCUSSION

The plant list revealed the floristic composition and aided in the characterization of the forests for each of the sampling sites and for the overall study site. The results of the survey showed that *Ficus septica* was the densest, most frequent, and most important species overall, and the top three most important species overall belonged to the genus *Ficus*.

In general, *Ficus* is the most well represented genera of the family Moraceae and is also the most species – rich genus of woody plants in Asia (La Frankie, 2010). The success of this species in the area is mainly attributed to its interactions with other species, which makes it successful in terms of reproduction. Animals such as birds, bats, and rodents eat the fruit of the trees which in turn helps in the dispersal of the seeds. Also, wasps facilitate the pollination of these species; this ensures and makes pollination more efficient.

The location of the site can also be attributed to the success of this genus, with an average of 300 meters above sea level, and the presence of water bodies in the area such as rivers and streams. The foothills of Sierra Madre provide the perfect habitat for *Ficus*, as it prefers rich soils and wet environment (La Frankie, 2010). *Ficus* species are usually associated with lowland dipterocarp forests.  They mostly find their uppermost limit in the colline subzone which is the height between 500 to 1000 meters above sea level. Only a few species of *Ficus* occurs in highly elevated areas.

It is no surprise that the genus *Ficus* thrives in this area, as it is one of the few genera of plants that is diverse and abundant in all tropical lowland and moisture-rich forests, especially in Tropical Asian countries like in the Philippines (Corlett, 2006). Also, the elevation of the area matches the prerequisite needed by the genus for it to thrive. Thus, the mode of pollination, interaction with other species, moisture content, and elevation of the area made it conducive for the flourishment of the *Ficus* genus.

Even though *Ficus septica*, is the most important species in the overall site, evaluation revealed that there are different important species per site. *Bombax ceiba* is the most important species in site one even though it only occurred once in the entire area. The reason for this is that the dominance of this species is high because of its high basal area. The second site had *Sandoricum koetjape* as the most important species, it is commonly known as Santol; it is mostly found in lowland forests and is widely planted for economic purposes (La Frankie, 2010). Site 3's most important species is *Mangifera indica*. The mango became the most important species in this site because a portion of the area was converted into a Mango plantation for economic purposes. Due to the high number of Mango in the area, this affected the diversity of the plants present, making it the most important species in this area. Of the three sites, it can be observed that introduced species have thrived here, because it was cultivated in the area. This implies that the area has been inhabited by humans and mangoes became a source of fruits for commerce.

The foothills in Sierra Madre can be classified as a secondary forest. It contains all the characteristics of a secondary forest, namely, tree species with low diameter at base height (DBH), most species are secondary – growth trees, and the presence of disturbances in the area (Bradshaw *et al.* 2009). Compared to the Palanan Permanent plot (PPP) in Isabela province, floristic composition is only 25% similar than of its Palanan counterpart. The PPP in Isabela can be a model of what a relatively undisturbed forest looks like, because it is far from anthropogenic activities and is a highly protected area. The difference of the study site and the PPP can be attributed to many factors, one of which is the elevation. The elevation in the Palanan is 800 meters above sea level, while the study site only has an average near 300 meters. Other differences are the geographic location, and different anthropogenic activities in the two areas.

Majority of the listed tree species are native in origin, with only 22.22% being non - native. According to the IUCN, little or no introduction of non – native species corresponds to lack of human disturbances. With the data at hand, it can be seen that although the forest fragments in the foothills of Sierra Madre are secondary in nature, exotic species are seldom introduced. Those that replaced the pioneer species in the area are replaced with secondary growth species that are still naturally growing in Sierra Madre. This implies that anthropogenic activities, although present, do not affect the composition in a way that can damage the biodiversity in the area.

# CHAPTER VI

# CONCLUSIONS

The foothills in Sierra Madre, like the one in San Mateo, Rizal, can give an important insight to understanding the dynamics of urban and non-urban interface. Since the study area is close to developing areas, it can be made as a model to how urban development affects floristic compositions near a forest area. Since the management of Timberland, San Mateo, Rizal has moved to conserve the area, the study could be useful in helping conservation efforts.

In the increasing awareness of the public in the effects of deforestation, it is important that these kinds of studies are done to support agencies in formulating laws and policies that would help in conserving forests.

The forest fragments in San Mateo, Rizal has been classified as a secondary forest, that is mostly composed of native species. It is important that this classification of the forest be maintained so that the forest fragment can maintain its biological uniqueness and diversity (Mckinney, 2002). Also, the replacement of native trees with non – native ones can be detrimental to the natural composition of the forest, as non – native species compete for nutrients and do not encourage the survival of wild life (Lamb, 2010).

## RECOMMENDATIONS

The proponent of the study recommends that biodiversity indices be used to further elucidate the situation of the forest fragment. Different biodiversity indices yield different interpretations, so it is recommended that various indices be used so that correlations between floristic compositions and biodiversity ratings can be established.

It is also advised that other ecological factors such as tree distribution, light intensity, forest canopy cover, elevation, edaphic factors and atmospheric factors are determined and correlated to the floristic composition for a more in depth understanding on forest mechanics. The use of statistical tools such as Canonical Correspondence Analysis or CCA can also be suggested.

Conservation wise, it is recommended that conservation efforts be done in the area and introduction of invasive and exotic species be prevented. It is important to preserve the natural floristic composition of the foothills of Sierra Madre. Policies should be made so even in the occurrence of urban developments, the forests can be maintained.

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**Appendix A**

Table 1. Overall Computed Vegetation Diversity Parameters in the Three Study Sites

| **Tree Species** | D | RD | Do | Rdo | F | RF | IV | IP |
|---|---|---|---|---|---|---|---|---|
| *Albizia procera* | 0.0021 | 4.1145 | 0.0561 | 2.6995 | 0.2963 | 3.5242 | 10.3382 | 3.4461 |
| *Albizia sp.* | 0.0005 | 0.8945 | 0.0112 | 0.5382 | 0.1111 | 1.3216 | 2.7543 | 0.9181 |
| *Antidesma bunius* | 0.0001 | 0.1789 | 0.0036 | 0.1715 | 0.037 | 0.4405 | 0.7909 | 0.2636 |
| *Antidesma ghaesembilla* | 0.0014 | 2.6834 | 0.0105 | 0.5066 | 0.2593 | 3.0837 | 6.2737 | 2.0912 |
| *Arthrophyllum ahernianum* | 0.0001 | 0.1789 | 0.0018 | 0.0875 | 0.037 | 0.4405 | 0.7069 | 0.2356 |
| *Artocarpus blancoi* | 0.0022 | 4.2934 | 0.0132 | 0.6351 | 0.4444 | 5.2863 | 10.2149 | 3.405 |
| *Artocarpus heterophyllus* | 0.0024 | 4.6512 | 0.0132 | 0.6333 | 0.3333 | 3.9648 | 9.2492 | 3.0831 |
| *Artocarpus odoratissimus* | 0.0001 | 0.1789 | 0.1164 | 5.6008 | 0.037 | 0.4405 | 6.2202 | 2.0734 |
| *Bauhinia malabarica* | 0.0003 | 0.5367 | 0.0457 | 2.2001 | 0.1111 | 1.3216 | 4.0583 | 1.3528 |
| *Bombax ceiba* | 0.0003 | 0.5367 | 0.1506 | 7.2469 | 0.1111 | 1.3216 | 9.1052 | 3.0351 |
| *Breynia cernua* | 0.0001 | 0.1789 | 0.0045 | 0.2185 | 0.037 | 0.4405 | 0.8379 | 0.2793 |
| *Buchanania arborescens* | 0.000 | 0.1789 | 0.037 | 1.8197 | 0.037 | 0.4405 | 2.4391 | 0.813 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 1 | | 8 | | | | | |
| *Canarium asperum* | 0.0001 | 0.1789 | 0.0025 | 0.1219 | 0.037 | 0.4405 | 0.7413 | 0.2471 |
| *Canarium hirsutum* | 0.0001 | 0.1789 | 0.0027 | 0.1303 | 0.037 | 0.4405 | 0.7497 | 0.2499 |
| *Chrysophyllum cainito* | 0.0003 | 0.5367 | 0.0242 | 1.1633 | 0.0741 | 0.8811 | 2.5811 | 0.8604 |
| *Coffea sp.* | 0.0001 | 0.1789 | 0.002 | 0.0983 | 0.037 | 0.4405 | 0.7177 | 0.2392 |
| *Commersonia bartramia* | 0.0001 | 0.1789 | 0.0106 | 0.5125 | 0.037 | 0.4405 | 1.1319 | 0.3773 |
| *Cordia dichotoma* | 0.0001 | 0.1789 | 0.0175 | 0.841 | 0.037 | 0.4405 | 1.4604 | 0.4868 |
| *Dioxylum indicum* | 0.0001 | 0.1789 | 0.0291 | 1.4002 | 0.037 | 0.4405 | 2.0196 | 0.6732 |
| *Eucalyptus sp.* | 0.0003 | 0.5367 | 0.0525 | 2.5274 | 0.037 | 0.4405 | 3.5046 | 1.1682 |
| *Ficus minahassae* | 0.0001 | 0.1789 | 0.3563 | 17.1525 | 0.037 | 0.4405 | 17.7719 | 5.924 |
| *Ficus nota* | 0.0068 | 13.059 | 0.0182 | 0.875 | 0.7407 | 8.8106 | 22.7446 | 7.5815 |
| *Ficus pseudopalma* | 0.0004 | 0.7156 | 0.0048 | 0.2314 | 0.1111 | 1.3216 | 2.2685 | 0.7562 |
| *Ficus septica* | 0.0077 | 14.8479 | 0.0094 | 0.4541 | 0.8519 | 10.1322 | 25.4342 | 8.4781 |
| *Ficus ulmifolia* | 0.0002 | 0.3578 | 0.0038 | 0.1815 | 0.0741 | 0.8811 | 1.4203 | 0.4734 |
| *Ficus variegata* | 0.0001 | 0.1789 | 0.0236 | 1.1342 | 0.037 | 0.4405 | 1.7536 | 0.5845 |
| *Gliricidia sp.* | 0.0021 | 4.1145 | 0.0053 | 0.2541 | 0.3704 | 4.4053 | 8.7739 | 2.9246 |
| *Glochidion album* | 0.0001 | 0.1789 | 0.0277 | 1.3311 | 0.037 | 0.4405 | 1.9505 | 0.6502 |
| *Glochidion cuminii* | 0.0001 | 0.1789 | 0.0036 | 0.1715 | 0.037 | 0.4405 | 0.7909 | 0.2636 |
| *Gmelina arborea* | 0.0003 | 0.5367 | 0.1794 | 8.6362 | 0.037 | 0.4405 | 9.6134 | 3.2045 |
| *Gmelina sp.* | 0.0006 | 1.0733 | 0.1223 | 5.8892 | 0.0741 | 0.8811 | 7.8436 | 2.6145 |
| *Grewia laevigata* | 0.0001 | 0.1789 | 0.0066 | 0.3159 | 0.037 | 0.4405 | 0.9353 | 0.3118 |
| *Guioa koelreutaria* | 0.0004 | 0.7156 | 0.0029 | 0.1411 | 0.1111 | 1.3216 | 2.1783 | 0.7261 |
| *Lagerstromia speciosa* | 0.0004 | 0.7156 | 0.0067 | 0.3226 | 0.1481 | 1.7621 | 2.8003 | 0.9334 |
| *Leea guineensis* | 0.0001 | 0.1789 | 0.0035 | 0.1667 | 0.037 | 0.4405 | 0.7861 | 0.262 |
| *Lepisanthes fruticosa* | 0.0004 | 0.7156 | 0.0068 | 0.326 | 0.1111 | 1.3216 | 2.3631 | 0.7877 |
| *Leucaena leucocephala* | 0.003 | 7.1556 | 0.024 | 1.1749 | 0.185 | 2.2026 | 10.533 | 3.511 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 7 | | 4 | | 2 | | 1 | |
| *Leukocyte capitellata* | 0.0003 | 0.5367 | 0.0025 | 0.1219 | 0.0741 | 0.8811 | 1.5396 | 0.5132 |
| *Litsea cordata* | 0.0001 | 0.1789 | 0.0067 | 0.3226 | 0.037 | 0.4405 | 0.942 | 0.314 |
| *Litsea glutinosa* | 0.001 | 1.9678 | 0.0082 | 0.3963 | 0.3333 | 3.9648 | 6.3288 | 2.1096 |
| *Macaranga tanarius* | 0.0049 | 9.4812 | 0.0078 | 0.3772 | 0.5556 | 6.6079 | 16.4663 | 5.4888 |
| *Mangifera indica* | 0.0012 | 2.3256 | 0.1498 | 7.2119 | 0.2963 | 3.5242 | 13.0618 | 4.3539 |
| *Melicope triphylla* | 0.0007 | 1.4311 | 0.0034 | 0.1647 | 0.1852 | 2.2026 | 3.7985 | 1.2662 |
| *Mitragyna speciosa* | 0.0005 | 0.8945 | 0.0209 | 1.0045 | 0.037 | 0.4405 | 2.3395 | 0.7798 |
| *Musaenda philippica* | 0.0003 | 0.5367 | 0.0037 | 0.1765 | 0.0741 | 0.8811 | 1.5942 | 0.5314 |
| *Nephelium lappaceum* | 0.0002 | 0.3578 | 0.0077 | 0.3714 | 0.0741 | 0.8811 | 1.6102 | 0.5367 |
| *Parkia timoriana* | 0.0001 | 0.1789 | 0.0455 | 2.1878 | 0.037 | 0.4405 | 2.8072 | 0.9357 |
| *Persea americana* | 0.0003 | 0.5367 | 0.0365 | 1.7564 | 0.1111 | 1.3216 | 3.6147 | 1.2049 |
| *Pipturus asper* | 0.0001 | 0.1789 | 0.006 | 0.2899 | 0.037 | 0.4405 | 0.9093 | 0.3031 |
| *Pittosporum pentandrum* | 0.0001 | 0.1789 | 0.0032 | 0.1525 | 0.037 | 0.4405 | 0.7719 | 0.2573 |
| *Premna odorata* | 0.0001 | 0.1789 | 0.0336 | 1.6181 | 0.037 | 0.4405 | 2.2375 | 0.7458 |
| *Psidium guajava* | 0.0004 | 0.7156 | 0.015 | 0.7239 | 0.1111 | 1.3216 | 2.761 | 0.9203 |
| *Pterocarpus indicus* | 0.0002 | 0.3578 | 0.0339 | 1.6332 | 0.0741 | 0.8811 | 2.872 | 0.9573 |
| *Sandoricum koetjape* | 0.0042 | 8.0501 | 0.0279 | 1.342 | 0.4444 | 5.2863 | 14.6784 | 4.8928 |
| *Semecarpus cuneiformis* | 0.0004 | 0.7156 | 0.0032 | 0.1525 | 0.037 | 0.4405 | 1.3086 | 0.4362 |
| *Semecarpus sp.* | 0.0001 | 0.1789 | 0.0023 | 0.1098 | 0.037 | 0.4405 | 0.7292 | 0.2431 |
| *Syzygium cumini* | 0.0001 | 0.1789 | 0.1283 | 6.1749 | 0.037 | 0.4405 | 6.7943 | 2.2648 |
| *Syzygium sp.* | 0.0001 | 0.1789 | 0.0906 | 4.362 | 0.037 | 0.4405 | 4.9814 | 1.6605 |
| *Vitex negundo* | 0.0003 | 0.5367 | 0.0045 | 0.2185 | 0.037 | 0.4405 | 1.1957 | 0.3986 |
| *Vitex parviflora* | 0.0002 | 0.3578 | 0.0034 | 0.1619 | 0.0741 | 0.8811 | 1.4007 | 0.4669 |
| *Rubia wendlandia* | 0.0005 | 0.8945 | 0.0136 | 0.657 | 0.1111 | 1.3216 | 2.8731 | 0.9577 |
| *Wrightia laevis* | 0.001 | 3.0411 | 0.008 | 0.4023 | 0.259 | 3.0837 | 6.5271 | 2.175 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 6 | | 4 | | 3 | | | 7 |

## Appendix B

| **Tree Species** | **Family** | **Tree Species** | **Family** |
|---|---|---|---|
| *Albizia procera* | Fabaceae | *Grewia laevigata* | Malvaceae |
| *Albizia sp.* | Fabaceae | *Guioa koelreutaria* | Sapindaceae |
| *Antidesma bunius* | Phyllantacea | *Lagerstromia speciosa* | Lythraceae |
| *Antidesma ghaesembilla* | Phyllantacea | *Leea guineensis* | Vitaceae |
| *Arthrophyllum ahernianum* | Araliaceae | *Lepisanthes fruticosa* | Sapindaceae |
| *Artocarpus blancoi* | Moraceae | *Leucaena leucocephala* | Fabaceae |
| *Artocarpus heterophyllus* | Moracea | *Leukocyte capitellata* | Euphorbiaceae |
| *Artocarpus odoratissimus* | Moraceae | *Litsea cordata* | Lauraceae |
| *Bauhinia malabarica* | Fabaceae | *Litsea glutinosa* | Lauraceae |
| *Bombax ceiba* | Malvaceae | *Macaranga tanarius* | Euphorbiaceae |
| *Breynia cernua* | Phyllantacea | *Mangifera indica* | Anacardiaceae |
| *Buchanania arborescens* | Anacardiaceae | *Melicope triphylla* | Rutaceae |
| *Canarium asperum* | Burseraceae | *Mitragyna speciosa* | Rubiaceae |
| *Canarium hirsutum* | Burseraceae | *Musaenda philippica* | Rubiaceae |
| *Chrysophyllum cainito* | Sapotaceae | *Nephelium lappaceum* | Sapindaceae |
| *Coffea sp.* | Rubiaceae | *Parkia timoriana* | Fabaceae |
| *Commersonia bartramia* | Malvaceae | *Persea americana* | Lauraceae |
| *Cordia dichotoma* | Boraginaceae | *Pipturus asper* | Urticaceae |
| *Dioxylum indicum* | Bignoniaceae | *Pittosporum pentandrum* | Pittosporaceae |
| *Eucalyptus sp.* | Myrtaceae | *Premna odorata* | Lamiaceae |
| *Ficus minahassae* | Moraceae | *Psidium guajava* | Myrtaceae |
| *Ficus nota* | Moraceae | *Pterocarpus indicus* | Fabaceae |
| *Ficus pseudopalma* | Moraceae | *Sandoricum koetjape* | Meliaceae |
| *Ficus septica* | Moraceae | *Semecarpus cuneiformis* | Anacardiaceae |
| *Ficus ulmifolia* | Moraceae | *Semecarpus sp.* | Anacardiaceae |
| Ficus variegata | Moraceae | *Syzygium cumini* | Myrtaceae |
| *Gliricidia sp.* | Fabaceae | *Syzygium sp.* | Myrtaceae |
| *Glochidion album* | Phyllantaceae | *Vitex negundo* | Lamiaceae |
| *Glochidion cuminii* | Phyllantaceae | *Vitex parviflora* | Lamiaceae |

| | | | |
|---|---|---|---|
| *Gmelina arborea* | Lamiaceae | *Wendlandia luzonensis* | Rubiaceae |
| *Gmelina sp.* | Lamiaceae | *Wrightia laevis* | Apocynaceae |