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Vegetation survey and roadmap update of UP Arboretum



VEGETATION SURVEY AND ROAD MAP UPDATE OF THE UP ARBORETUM

by

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ABSTRACT

The UP Arboretum is a repository of endangered, endemic, and exotic plant species, which has evolved into a man-made forest. The existence of the Arboretum has educational, scientific and aesthetic significance. The dynamics of the vegetation composition within this forest has implications in larger forest ecosystems. A number of studies tackling different aspects of UP Arboretum ecosystem have been conducted. However, an accurate map of the area, that would facilitate these studies, has never been made. This work aims to survey the vegetation composition of the Arboretum and in the process create a more updated map of the area. In the survey a total of six genera were included, namely, *Bauhinia sp.*, *Erythrina sp.*, *Leucaena sp.*, *Pithecellobium dulce*, *Tectona grandis*, and *Triplaris cumingiana*.

INTRODUCTION

The area of the earth known as the tropics is the region bound by 23.5° north latitude and 23.5° south latitude. Due to its location, it is the region of the earth which experiences the greatest annual input and the least seasonal variation in solar radiation. Intense solar radiation near the equator initiates a global circulation of air, creating precipitation and winds. High temperatures in the tropics evaporate water from earth's surface and cause warm, wet air masses to rise and flow toward the poles. The rising air masses release much of their water content, creating abundant precipitation in tropical regions. Thus, high temperatures, intense sunshine, and ample rainfall are all characteristic of a tropical climate, fostering the growth of lush vegetation in some tropical forests and the development of coral reefs

(Campbell 1999). The Philippines is in the tropical region.

Watson *et al* said that tropical forests represent about 40% of the world's forested area and contain about 60% of global forest biomass. Tropical forests have a strong influence on local and regional climate, play a significant role in the global carbon budget, and contain a remarkably large share of all plant and animal species of the world. Moreover, tropical and subtropical forests are economically very important, providing commercial products for national and international markets. He further cited that tropical forests are likely to be more affected by changes in soil water availability (e.g., from seasonal droughts or soil erosion and nutrient leaching resulting from heavy rainfall events) and possibly by CO₂ fertilization than by changes in temperature. Nutrient leaching, erosion, and timber harvesting also

are likely to result in decreased biomass and biodiversity.

An arboretum is a botanical garden exhibiting trees for their scientific interest and educational value, and in association with appropriate wildlife features (Marckwardt *et al* 1998). The University of the Philippines Arboretum is a 16-hectare man-made forest within the 98.5-hectare Commonwealth property of U.P. Diliman, a vast 493-hectare academic institution in the heart of Quezon City, Philippines. The Diliman campus is a part of the expansion program of the original U.P. campus established in 1908 along Padre Faura Street, Manila. Commonwealth Act Number 442 signed on June 3, 1939 by President Manuel L. Quezon made this transfer from Manila to Quezon City (formerly a part of the Mariquina Estate) possible. The construction of the Don Mariano Marcos Avenue (now Commonwealth Avenue) in 1957 intersected the campus from east to west on its upper northern section, effectively separating approximately 20% of the campus from its entirety. Thus in subsequent years, the area originally designated as a Parks and Athletics Zone (PAZ) gave way to structures such as the Philippine Nuclear Research Institute, the National Hydraulic Research Center, the Philippine National Oil Company, the Philippine Social Science Center, the Asian Institute of Tourism, and the U.P. Arboretum. It must also be noted that there has been a consistent increase in squatter population since.

The U.P. Arboretum was established in 1948 under the Reforestation Administration (RA) of the Department of Agriculture and Natural Resources (DANR) to serve as a nursery in the forestation activities of the RA in nearby localities. Trees were

planted to modify the micro-environmental conditions of the nursery, as it was originally a grassland containing a few fruit-bearing trees such as mango (*Mangifera indica* L.) and tamarind (*Tamarindus indica* L.). The administrative jurisdiction of the nursery was officially transferred from the RA to U.P. Diliman on August 15, 1962. Its operation has then expanded from a nursery to a repository of endangered, endemic, and exotic plant species, which after some time successfully evolved into a man-made forest (Sotalbo 1986). The latest study shows that it is home to 77 out of 192 plant species in the University, comprising 9,298 plants of the total 38,569 we have, the most in any major grid of U.P. Diliman (Sotalbo 2001).

With all of these put into consideration, the need for a formal study of the U.P. Arboretum should not be disputed. Mr. Emiliano D. Sotalbo, the present Director of the Campus Maintenance Office (CMO), and previous classes of Biology 160 (Ecology) have conducted studies on floristic composition, specifically species density and diversity, as well as analyses of soil samples. Yet, an accurate map of the Commonwealth property, specifically the Arboretum area, has never been made.

This study aims to survey the vegetation composition and to come up with an updated map of the UP Arboretum.

MATERIALS AND METHODS

Road Mapping. Mapping of the existing roads in the arboretum started from the road stemming from the commonwealth avenue and included roads leading to the PNRI, Hydraulic center, dump site, and

residential areas. The compass feature of the handheld GPS (Garmin) was used to determine the bearing of the roads. The entire length and width of the roads were measured using transect lines. The straightness of the line was maintained by having the person at one end, with the use of the compass, make sure that the person at the other end of the line maintains the bearing.

Description of the Sampling Sites. (Refer to map) Two of the areas where density of vegetation seemed to be greatest were designated as sampling sites. The first study site is bordered on its south side by the road approximately parallel to the commonwealth avenue. It is delimited on its north (refer to fig. 1) and west sides by grassland areas. Its boundary to the west is the road leading to the residential areas. The second sampling is located west of the first sampling site. It is bounded on the bottom by the road leading to the Hydraulic center. The road leading to the residential areas is its boundary to the east. A clearing delimits the second site on the north side. Its west border is the residential areas.



Fig 1. Ecotonal area delimiting site 1 on the north

Vegetation Sampling. The line-intercept method was employed in vegetation sampling. The longest possible line cutting across the sampling site, was determined. The bearing of this line from one point to the other end was ascertained and maintained during the survey. The plants intercepted along this line were taken as samples, characterized and identified. The plant species taken into consideration were limited to plants with dbh values greater than or equal to 13cm. For the first site a bearing of 15° north of west was maintained from the bottom right corner of the sampling site (refer to map) until its top left corner. A 50° north of west bearing was similarly maintained for the second sampling site.

Identification. Morphological features of the vegetative parts, mainly leaf morphology, were used as bases for identification of the plants. A “taxo-notebook” from the Ecology class, which contained specimens earlier taken from the arboretum, was used as a guide. The specimens in this notebook were characterized and identified with the aid of Mr. Ramon Bandong, a laboratory aide in the Institute of Biology.

RESULTS AND DISCUSSION

Map. (Refer to map) Mapping of the existent roads was accomplished.

Vegetation. Six different genera of trees were identified. Four of the surveyed genera belong to the legume family - Leguminosae, namely *Pithecollobium dulce*, *Bauhinia sp.*, *Erythrina sp.* and *Leucaena sp.* *Tectona grandis*, a member of the family Verbenaceae was also



Fig. 2 *Bauhinia sp.* Note the characteristic bilobed leaves.

included in the sampling. Lastly, a member of the family Polygonaceae was also sampled, *Triplaris cumingiana*. For site 1, four species were identified, namely *Tectona grandis*, *Bauhinia sp.*, *Leucaenia sp.* and *Pithecellobium dulce*. While *Tectona grandis*, *Bauhinia sp.*, *Triplaris cumingiana*, and *Erythrina sp.* were located along the line established in site 2. Descriptions and taxonomic information were lifted from Sotalbo (2001), Watson (1992) and Plants.com.

Kingdom Plantae – Plants
 Subkingdom Tracheobionta – Vascular plants
 Superdivision Spermatophyta – Seed plants
 Division Magnoliophyta – Flowering plants

 Class Dicotyledonae – Dicotyledons
 Subclass Rosidae –
 Order Fabales –
 Family Leguminosae – legume family
 Genus *Bauhinia* L. – bauhinia

Common name: Orchid tree, butterfly tree, Alibangbang. This tree is named after the Bauhin

brothers who were Swiss botanists in the 16th-17th century.

Description: This is a short tree which can grow up to 10m in height and 40cm in diameter. It has broad bilobed leaves with a cordate base.

Habitat: It is common in areas with a distinct dry season. It grows best with full sun exposure to a light shade. These trees will grow well in moist, well drained, acidic (pH 5.5 - 6.5) soil in a sunny location.

Origin and Distribution: This plant is native to India, China, Burma, Thailand, Cambodia, Laos, Vietnam, Philippines, Malesia, and South Africa

Use: Its wood is used for firewood and charcoal. Young foliage and blossoms are eaten as vegetables in some countries. Its pink and purple orchid-like



Fig. 3 *Erythrina variegata* (Carr, GD)

flowers make it a prized ornamental plant.

Kingdom Plantae – Plants
Subkingdom Tracheobionta – Vascular plants
Superdivision Spermatophyta – Seed plants
Division Magnoliophyta – Flowering plants

Class Dicotyledonae – Dicotyledons
Subclass Rosidae –
Order Fabales –
Family Leguminosae – Legume family
Genus *Erythrina* L. – erythrina

Common name: Dapdap, mulungu

Description: This is a medium-sized deciduous tree, its height ranging from 10-20m and its dbh is around 1m. It has blunt spines on the trunk and branches. Leaflets are ovate-triangular-rhomboid shaped. Dapdap leaves are trifoliate.

Habitat: This plant thrives in a range of habitat types, from tropical dry to wet and subtropical dry to wet forests. *Erythrina* grows in a variety of conditions but shows a preference for lowland areas. Dapdap is estimated to tolerate annual precipitation of 10 to 40 dm, annual temperature of 20 to 28°C, and soil pH of 6 to 8.

Origin and Distribution: This is indigenous to India, the Malay peninsula, Polynesia and the Philippines.

Uses: It is prized as an ornamental tree because of its showy flowers. Its also used by herbalists as medicine and poison. Young Dapdap leaves are eaten either

raw or boiled in certain countries. It's wood is



Fig. 4 *Leucaena leucocephala* (Carr, GD)

lightweight and thus is weak, not durable, and unsuitable as lumber.

Kingdom Plantae – Plants
Subkingdom Tracheobionta – Vascular plants
Superdivision Spermatophyta – Seed plants
Division Magnoliophyta – Flowering plants

Class Dicotyledonae – Dicotyledons
Subclass Rosidae –
Order Fabales –
Family Leguminosae – Legume family
Subfamily Mimosoideae
Genus *Leucaena* Benth. – leadtree

Common name: Ipil-ipil, lead tree, wild tamarind, cow tamarind, shack shack, and koa haole

Description: This is a small deep rooted tree or arborescent shrub which can grow to 6m or higher.

Its leaves are bipinnate, with oblong to lanceolate leaflets, of a It has flat, strap-shaped, and shiny brown pods.

Habitat: All leucaenas are woody perennials occurring in secondary forests. Ipil doesn't grow too well on soils under pH 5, this is attributed to its low tolerance of free aluminum and high calcium requirements. Its growth performance is excellent on coralline and other calcareous sites up to pH 8. It generally favors limestone soils and disturbed areas and is found in dry to mesic habitats. Mesic soils are soils that drain well and yet retain water. It also grows on wet disturbed areas. New seedlings rapidly reestablish stands after disturbances, such as fires. Growth in saline soils is low, but it can be found on alkaline soils. It shows a wide range of tolerance to heat and desiccation.

Origin and Distribution: *Leucaena* is a native of tropical America, but it has been naturalized in most tropical areas and has become pantropical. It's also widely distributed in Micronesia.

Uses: This species has been extensively planted in the Philippines as reforestation species and for the control of soil erosion. Wood is used as fuelwood, lumber, pulpwood (paper, rayon), craftwood, craftwood and charcoal. Uses of foliage include green manure, food (juvenile shoots) and animal feed. It's grown as fodder plant for cattle in pastures. It is one of the few woody tropical legumes that is highly digestible and relatively non-toxic.

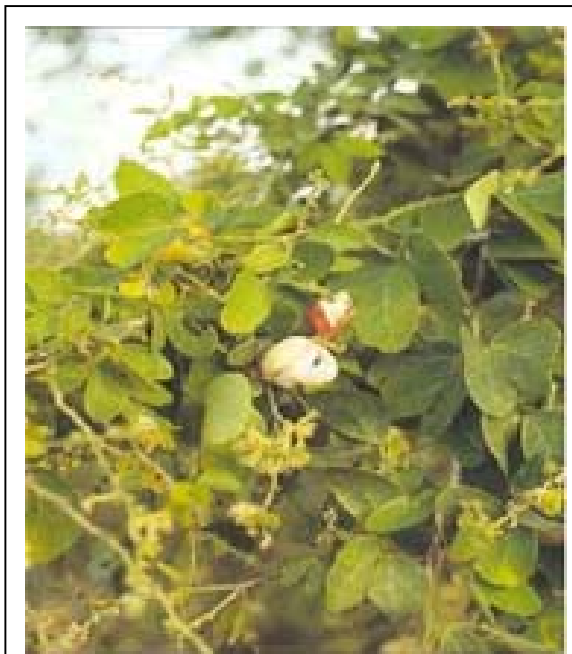


Fig. 5 *Pithecellobium dulce*
(<http://www.hear.org/pier/scinames.htm>)

Kingdom	Plantae – Plants
Subkingdom	Tracheobionta – Vascular plants
Superdivision	Spermatophyta – Seed plants
Division	Magnoliophyta – Flowering plants
Class	Dicotyledonae – Dicotyledons
Subclass	Rosidae –
Order	Fabales –
Family	Leguminosae– Legume family
Genus	<i>Pithecellobium</i> Mart. – blackbead
Species	<i>Pithecellobium dulce</i> (Roxb.) Benth.

Common name: Kamachile, Monkeypod, Manila tamarind, Madras thorn

Description: This is a large tree which can grow to 20m or more in height. Kamachile has a broad crown of up to 30m across. It has a spiny trunk. Its leaves

are bipinnate compound leaves, with each pinnae bearing a single pair of oblique, obovate, obtuse leaflets. Pods are turgid, irregularly swollen, twisted, spirally dehiscent along the lower suture. Pods are usually 6-8 seeded with a sweet white edible pulp. Seeds are black and arelate.

Habitat: It's habitat ranges from tropical desert, subtropical desert to moist forest. It tolerates temperatures of 18.0 to 27.9°C, and pH up to 8.3. Kamachile is suitable for most dry regions and is drought resistant. It has great adaptability and in low rainfall areas develops an extensive root system. Kamachile grows on most soil types, including clay, oolitic limestone, and barren sands. It can also be found in wet sands that have a brackish water table.

Origin and Distribution: This is a native of Mexico and Central America, however it has been introduced to other tropical countries.

Uses: It's grown for its edible fruit. The pods contain a thick sweet, but acidic pulp, eaten raw or made into a drink similar to lemonade. Pods are devoured by livestock of all kinds; the leaves are

browsed by horses, cattle, goats, and sheep; and hedge clippings are often gathered for animal feed. The plants withstand heavy browsing by these animals. The seeds contain a greenish oil (20%), which, after refining and bleaching, can be used for food or in making soap. Bark is known to be used as a fish poison in the Philippines. Known in the Philippines as "Kamachile", the wood, is used for boxes, crates, fuel, and wagon wheels. The gum exuding from the trunk can be used for mucilage and the tannin for tanning.

Kingdom Plantae – Plants
 Subkingdom Tracheobionta – Vascular plants
 Superdivision Spermatophyta – Seed plants
 Division Magnoliophyta – Flowering plants
 Class Dicotyledonae – Dicotyledons
 Subclass Asteridae –
 Order Lamiales –
 Family Verbenaceae – Verbena family
 Genus *Tectona* L. f. – tectona
 Species *Tectona grandis* L. f. – teak

Common name: Teak

Description: This can grow to 25m in height and 1m in diameter. Its leaves are simple, chartaceous, dark green on the upper surface, and soft, pubescent on the lower surface. The leaves vary from ovate to round or obovately oblong. These are usually cuneate at the base with acuminate apices. The flowers are subsessile. Its fruits are ovately globose and enclosed by a persistent calyx.



Fig. 6 *Tectona grandis* (Carr, GD)

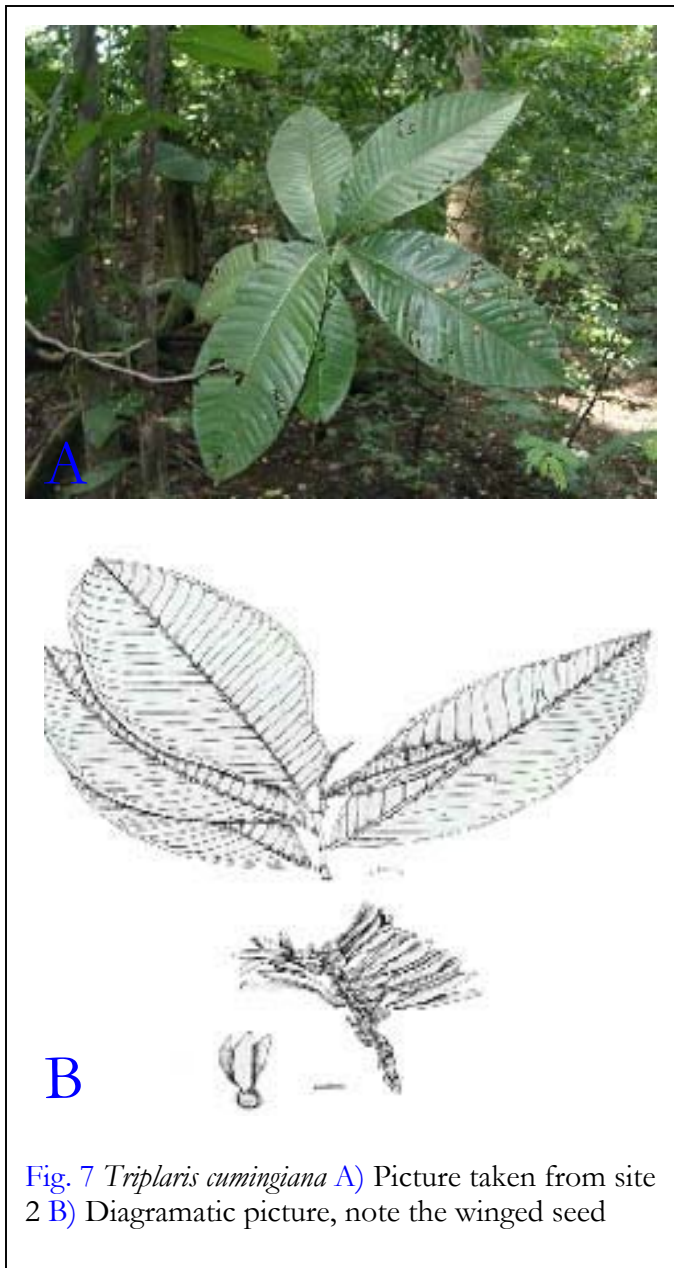


Fig. 7 *Triplaris cumingiana* A) Picture taken from site 2 B) Diagramatic picture, note the winged seed

Kingdom Plantae – Plants
 Subkingdom Tracheobionta – Vascular plants
 Superdivision Spermatophyta – Seed plants
 Division Magnoliophyta – Flowering plants
 Class Dicotyledonae – Dicotyledons
 Subclass Rosidae –
 Order Fabales –
 Family Polygonaceae – Buckwheat family
 Genus *Triplaris*
 Species *Triplaris cumingiana*

Common name: Palosanto, vara de Maria, palo hormiguero, pau formiga, long John, mira udu, mulato-tree, tangarana, anthill

Description: This is deciduous tall tree which grows to 10m in height and 30cm in diameter. Its most distinguishing feature is its hollow branchlets which house ants. The leaves are oblong and are pointed at both ends. This plant is dioecious. The flowers are rose-pink and have six petals each. Fruits are arelate, 3-angled and 3-winged with silky hairs.

Habitat: Growth preference for full sunlight, sandy loam, and well drained soil. Also, it has a tolerance for drought. It thrives in the swamp forests of Surinam. These swamp forests have heavy, grayish, silty clay. The soils in these forests are water logged for most of the year except for the dry season. It grows well in lowland, mesic valleys with moist soils rich in humus.

Habitat: Teak grows best in flat lands and on sites with mild slopes.

Origin and Distribution: This tree is a native to India and the Malay Peninsula.

Uses: Its wood is used as material for furniture-making and construction work. It was initially introduced to the Philippines as a reforestation species.

Origin and Distribution: The Palosanto is a native of tropical America

Uses: Palosanto is an ornamental plant, because of its showy fruits and flowers. The wood is also used for construction.

The occurrence of an organism is dependent on both characteristics intrinsic to it and external factors influencing its growth and proliferation. Intrinsic factors include habitat preference, reproductive mechanisms, and overall resistance to alterations in the environment. Environmental factors include soil type, climate, shading patterns, humidity, water availability, and ecological interactions and disturbances. (Lim and Medalla, 2001).

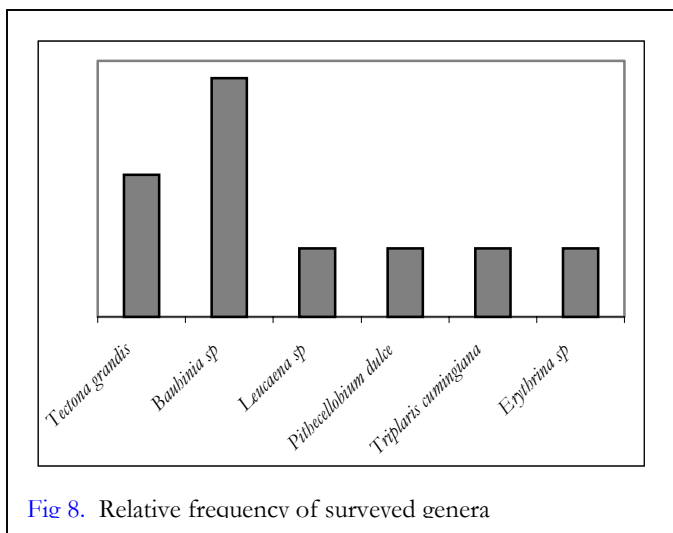


Fig 8. Relative frequency of surveyed genera

The physical and chemical properties of the soil influences the growth of plants. Clay soils make up most of UP Diliman soil (Lim and Medalla, 2001). Clay soils are adequately water retentive, thus, are ideal for certain plant genera with a preference for mesic soils. *Triplaris cumingiana* is an example of a plant that exhibits this preference. As previously mentioned, it thrives in the swamps of Surinam,

which consists of heavy silty clay. In fact, most plants grow optimally in mesic soils. On the other hand, kamachile or *Pithecellobium dulce* can grow in most soil types.

Soil acidity in the UP Diliman area is high to moderate (Ong and Villanueva, 1999). *Baubinia sp.* exhibits a preference for moist, well drained and acidic soils. However, *Leucaena sp.* cannot tolerate anything below pH 5 and *Erythrina sp.* grows optimally in soil with a pH near neutrality (pH 6-8). This could explain the difference in the relative frequency of these three genera (refer to fig. 1).

Topographical features, including elevation influences the occurrence of vegetation. The elevation of the Quezon City plateau averages around 70m above sea level (Dizon, 1952). This elevation creates a westward slope (Teves and Gonzales, 1950). This slope contributes to the adequate drainage of the soil, provided via small intermittent creeks flowing southwestward (Lim and Medalla, 2001).

An example of ecological disturbances includes anthropogenic factors. The close proximity of residential areas alters the composition of plant communities. Anthropogenic activities can modify the physical make-up of the terrain by introducing features such as gullies, trails and roads. As a result lower tree densities and greater ground cover exposure is observed. Furthermore the introduction of these features also has the potential to affect soil texture and chemistry, subsequently altering the vegetation composition.

In conclusion, the vegetation cover of UP Arboretum includes *Baubinia sp.*, *Leucaena sp.*, *Tectona grandis*, *Triplaris cumingiana*, *Erythrina sp.* and

Pithecellobium dulce. In this survey, the genera exhibiting the highest frequency is *Bauhinia sp.*

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