Annals of Tropical Research 33[2]:1-21(2011)

The Status of Floristic Analysis of Mt. Pangasugan, Leyte, Philippines - a Conservation Priority Area Classified as "Extremely High Critical"

Gerhard Langenberger[1] and Beatriz S. Belonias[2]

[1]University of Hohenheim, Institute of Plant Production and Agroecology in the Tropics and Subtropics (380b), 70593 Stuttgart, Germany; [2]Department of Biological Sciences, Visayas State University, Visca, Baybay City, Leyte, 6521-A Philippines

ABSTRACT

The island of Leyte in the Eastern Visayas takes a central position between the Philippine main islands of Luzon and Mindanao. It is characterized by the Leyte Cordillera, which is part of the Philippine fault line. Within the Leyte Cordillera, Mt. Pangasugan takes an exceptional role since it provides a catena from lowland forest remnants on its foothills to mossy forest on its summit at 1158 m a.s.l.. Recently, Mt. Pangasugan has been identified as conservation priority area classified as of 'extremely high critical' level.

Mt. Pangasugan has been the focus of comprehensive botanical studies within the last few years. We present the current status of the floristic assessment of the mountain and introduce the Visayas State University Herbarium, located at the foot of Mt. Pangasugan, where the majority of collected specimens are deposited. At present, the Herbarium houses c. 6100 specimens, 3000 of them originating from the primary forest of Mt. Pangasugan. Based on the present status of specimen processing and identification they represent 115 families, and 418 genera of Angiosperms, 2 families, 2 genera, and 3 species of Gymnosperms, 27 families and 64 genera of Pteridophytes, and 3 classes, 38 genera and 51 species of Bryophytes. The number of vascular plant species represented in the VSU Herbarium can safely be estimated at c. 800-1000. Given the small overall sampling area intensively studied so far these figures can be assumed as representing just a fraction of the total floristic richness of the area.

Keywords: bryophytes, spermatophytes, pteridophytes, Leyte Cordillera, plant collections, vascular plant species

Correspondence: G. Langenberger *Address:* University of Hohenheim, Institute of Plant Production and Agroecology in the Tropics and Subtropics (380b), 70593 Stuttgart, Germany
Email: langenbe@uni-hohenheim.de
DOI: 10.32945/atr3321.2011

INTRODUCTION

The Philippines has been acknowledged as important megadiversity hot spot in Southeast Asia (Myers *et al.*, 2000). It harbors c. 8120 angiosperm, 33 gymnosperm, and 1031 pteridophyte species (DENR and UNEP, 1997). The archipelago had been a center of comprehensive floristic studies at the beginning of the last century as has been documented by van Steenis (1950). Nevertheless, compared to the neighboring countries the flora of the Philippines is still little known as has been stressed by Kartawinata (1990), Soerianegara and Lemmens (1994), or Frodin (2001).

The Philippine archipelago is dominated by its two main islands which make up two thirds of the land surface, Luzon in the north and Mindanao in the south. The two islands are testimonies of the plant-geographic evolution in Southeast Asia. While the Philippines are basically characterized by Malaysian plant groups the vegetation of Luzon shows distinct floristic impacts from continental Asia as e.g. the two pine species *Pinus khesya* and *Pinus merkusii* or representatives of the higher latitude family Gentianaceae. Mindanao, on the other hand, shows the impact of Australian floristic elements, like the northernmost occurrence of the genus *Eucalyptus (E. deglupta*) (Dickerson, 1928, Merrill, 1945). Leyte and Samar form the central island group between these two entries of plant invasions. A better knowledge of their vegetation will improve our understanding of plant geographic processes in the Philippine archipelago.

On the island of Leyte, Mt. Pangasugan has been the focus of several comprehensive plant biodiversity studies. It is a distinct mountain on the west coast of the island. At its foot the Visayas State University (VSU) is located. VSU usually acts as base camp for floristic studies and inventories on the mountain. During a nationwide biodiversity priority-setting workshop Mt. Pangasugan and its environs have been identified as a conservation priority area of an "extremely high critical" level (Ong *et al.,* 2002, p. 90). However, despite this declaration, Mt. Pangasugan's biodiversity is continually threatened e.g. by mining activities.

Within this paper we present the floristic studies conducted on Mt. Pangasugan and give an overview of the plant taxa so far identified.

Additionally, we introduce the Visayas State University Herbarium, where most of the collections are deposited. The objective of this paper is to add to the knowledge of the Philippine flora as well as to focus the scientific as well as public view on this exceptional mountain.

The Island of Leyte and Mt. Pangasugan

The island of Leyte belongs to the biogeographic region of the Eastern Visayas (DENR and UNEP 1997). Together with the island of Samar it takes a central position between the Philippine main islands of Luzon and Mindanao (Figure 1).

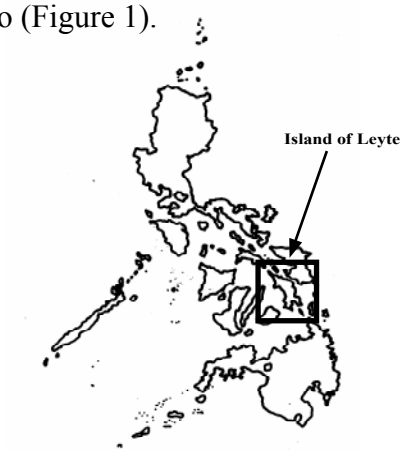

Figure 1. The location of Leyte

With 7448 km^2 Leyte is the eighth biggest island in the Philippine archipelago. It extends over a length of c. 214 km between 9°55' and 11°48' northern latitude, and between 124°17' and 125°18' eastern longitude. At its 'hip' it is only 25 km wide (Figure 2).

Leyte is a rugged and mountainous island. Its characteristic feature is the Leyte Cordillera, which belongs to the Philippine fault line and extends north to south over the whole length of the island. Due to its rugged relief and the resulting difficult accessibility pristine forests can still be found even in rather close vicinity to the densely populated coastal planes. A good example is Mt. Pangasugan (10°44' N, 124°48' E) on the western side of the island, which faces the Camotes Sea. It is located c. 8 km north of the provincial capital of Baybay and c. 34 km

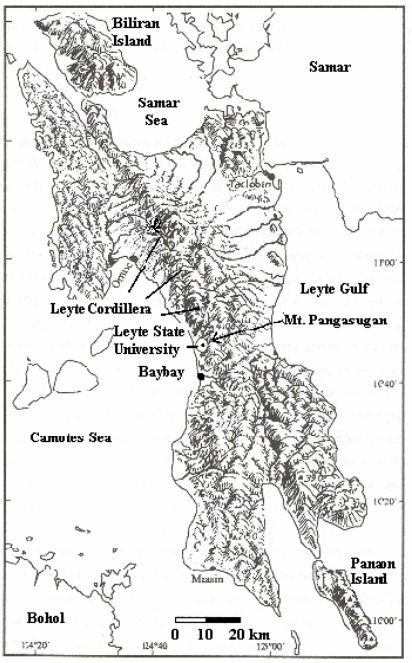

Figure 2. Leyte and the location of Mt. Pangasugan and the Visayas State University

south of Ormoc City. On the narrow coastal plane at its foot the Visayas State University (VSU) is located. Mt. Pangasugan is exceptional since it still provides a catena from lowland forest remnants on its foothills to mossy forest on its summit at c. 1158 m a.s.l..

Geologically, the bulk of Leyte consists of andesitic, basaltic and dacitic flows and breccia of Miocene age covered with lava flows and volcanoclastics (Asio, 1996). On the western foothills of Mt. Pangasugan at c. 400 - 500 m a.s.l. soil studies revealed dacitic and andesitic breccia as parent material and Haplic Andosols as the resulting soil (Zikeli, 1998).

Climatically, Leyte is characterized by a tropical monsoon climate, with no pronounced dry season (Kintanar, 1984). Calculations based on data from the PAGASA[1] Weather Station (7 m) on the Campus of the Visayas State University showed an annual average temperature of 27.4° C and an average annual precipitation of 2586 mm. Although, on

[1] Philippine Athmospheric, Geophysical and Astronomical Services Administration

average, no dry season occurs, rainfall distribution is not homogenous, and March to May receive with monthly 95 mm to 133 mm much less precipitation than November to January with 284 mm to 296 mm. Nevertheless, the variability of precipitation is high, and severe drought periods can be observed during El Niño Southern Oscillation Years (Langenberger, 2003). The contribution of orographic rains and clouds to the precipitation on the mountain slopes and summit has never been studied. But both definitely play an important role for vegetation development. Another important feature of the area is the occurrence of typhoons and the often associated landslides.

The Visayas State University (VSU) Herbarium and its Collections

The Visayas State University (VSU) Herbarium is a small but growing university herbarium affiliated to the university´s Department of Biological Sciences (DBS). It has been formally established in 1990 within the framework of a cooperation project between the Philippines and Germany[2]. The project was launched to improve the ecological conditions on Leyte. The task of the Herbarium is to act as a repository of voucher specimens from plant biodiversity studies on Mt. Pangasugan.

The Herbarium consists of a storage room with steel and glass cabinets and built-in hanging cupboards for storing herbarium specimens. It also has a working room equipped with work tables, pressers, two drying boxes, and a stereoscope, as well as a small taxonomic library. The Herbarium has been managed by the staff of the Department of Biological Sciences and has been operating initially using research funds from the cooperation project. At present, a very small part of the department's annual budget allocation sustains the unit in terms of needed supplies. Occasional support from collaborative researches of VSU staff and visiting scientists also help to improve the facility. The absence of a full-time staff in the Herbarium and the lack of important equipment like air-conditioner, or a computer, hamper its further development.

[2] "Philippine-German Environmental Research and Development Program", PN 88.2122.5-01.100

Insufficient taxonomic references are also a major problem.

Based on the current status of specimen processing and identification, the Herbarium houses a total of c. 5500 mounted specimens collected from various parts of Leyte Island, about 3000 of which come from the primary forests of Mt. Pangasugan. Around 1000 specimens were collected from other parts of Leyte, like Lake Danao in Ormoc, Mt. Lobi in Dagami and other localities on the island.

A considerable number (c. 2000) are backlog specimens that are already mounted but still need to be catalogued and identified. Furthermore, there are still collections especially from Mt. Janagdan, Ormoc, awaiting processing and final identification. Table 1 provides a summary of the present collection of the VSU Herbarium.

Table 1. The VSU Herbarium and its Collections

Collection localities	Number of specimens*
Mt. Pangasugan	c. 3000
Mt. Janagdan, Ormoc (not yet processed)	c. 600
Other localities on Leyte	c.1000
Miscellanious (students´ collections, exotics, etc.)	c. 1500
Total no. of specimens	**c. 6100**

*A considerable number of specimens has not yet been included in the data base. Therefore no exact figures are given.

Floristic research conducted on Mt. Pangasugan

First plant collections on the island of Leyte are documented for the beginning of the 20th century, e.g. by Cuming, Warburg, or Jagor (van Steenis, 1950). Since then floristic activities on Leyte have been rare as can be seen from the overview by Madulid and Agoo (1992). Neither van Steenis (1950) nor Madulid and Agoo (1992) mention Mt. Pangasugan as research or collection site.

But since the early 1990's Mt. Pangasugan has been the focus of comprehensive plant biodiversity studies. Floristic inventories of bryophytes and vascular plants were done by graduate students, visiting scientists and faculty researchers of the university. Except for the studies by Po (2000), Belonias (2002), and Langenberger (2003),

which were done primarily in the primary forests of Mt. Pangasugan, all other inventories included native, introduced as well as cultivated species. Since their results do not provide information relevant for an ecological evaluation of Mt. Pangasugan`s flora, they are not considered here. In 1992, there was also a floristic trip by the Philippine National Herbarium within the framework of the Flora of the Philippines Project. 30 specimens of that exploration are deposited at the VSU Herbarium. In Tables 4-6 we list all families and genera of spermatophytes (Table 4), pteridophytes (Table 5), and musci (Table 6) identified in the studies cited in table 2. We did not go down to species level. Due to the lack

Table 2. Floristic Studies Conducted on Mt. Pangasugan, Leyte, Philippines

Researcher & Year	Plant groups studied	No. of taxa identified
Langenberger 2003	Vascular plants	111 families, 289 genera, 685 species
Belonias 2002	Dicotyledons	75 families, 212 genera, 314 species
Po 2000	Monocotyledons	14 families, 51 genera, 77 species
Belonias & Bañoc 1994	Pteridophytes	24 families, 55 genera, 93 species
Quimio 1994	Bryophytes	3 classes, 38 genera, 51 species

of an updated taxonomic reference of Philippine vascular plants the problem of the application of synonyms and outdated names is abundant. A sound combination of the results of different studies would require a comprehensive check to avoid the use of such synonyms and to apply the same taxonomic classification system. Given the available resources this was not possible for all plant groups so far encountered. We therefore decided to stick to the family and generic level to avoid the impression of an accuracy which cannot be guaranteed at present. Additionally, this avoids the problem of how to tread morpho-species. Family and genus delimitation for spermatophytes follows the compilation by Gunn *et al.* (1992). For the Pteridophytes the classification scheme applied by Salgado (1990) in his checklist has been used to standardize the use of

family and genera names. In Table 3 the results for the vascular plants are given. So far 144 families and 484 genera of vascular plants have been identified for Mt. Pangasugan. In Figure 3 we present the 35 most common spermatophyte families concerning the number of genera. With 33 genera the Rubiaceae are by far the most genus-rich family. They are

Table 3. No. of Vascular Plants so far documented for Mt. Pangasugan*

	Spermatophytes	Pteridophytes	Total
Families:	117	27	144
Genera:	420	64	484

* The figures for the spermatophytes and pteridophytes are the result of a synthesis of the studies by Belonias & Bañoc (1994), Po (2000), Belonias 2002, and Langenberger (2003); the figures for the musci are from Quimio (1994)

followed by the mostly epiphytic orchids with 27 genera. Concerning terrestrial plants the Euphorbiaceae are second. Both terrestrial families rarely represent dominant trees. Mostly, their representatives are medium to small trees or shrubs. This stresses the importance of the undergrowth for the overall species richness in the area.

CONCLUSIONS

The importance of detailed local botanical studies has been stressed by Prance *et al.* (2000). Concerning the vascular plant taxa represented in this paper (Tables 4 and 5) it has to be noted that the numbers are mainly based on plot sampling covering an overall area of less than 1 ha. This is a tiny fraction of the still existing forest on Mt. Pangasugan, leave alone the Leyte Cordillera. From our current overview of the collections at the VSU Herbarium we estimate that they certainly represent 800 to 1000 vascular plant species. That the encounter of new or very rare taxa is just a matter of collecting can be seen from the findings of the last collections. Four new orchid species have been described from Mt. Pangasugan in the years 1996 to 1998 (Fessel and Lückel, 1996a, b, 1997, 1998). The *Schefflera* specimens (Araliaceae) at the VSU Herbarium contain one species, *S. leytensis* (GL 2462), which has been collected only once before, several decades ago, as well as three species still awaiting final

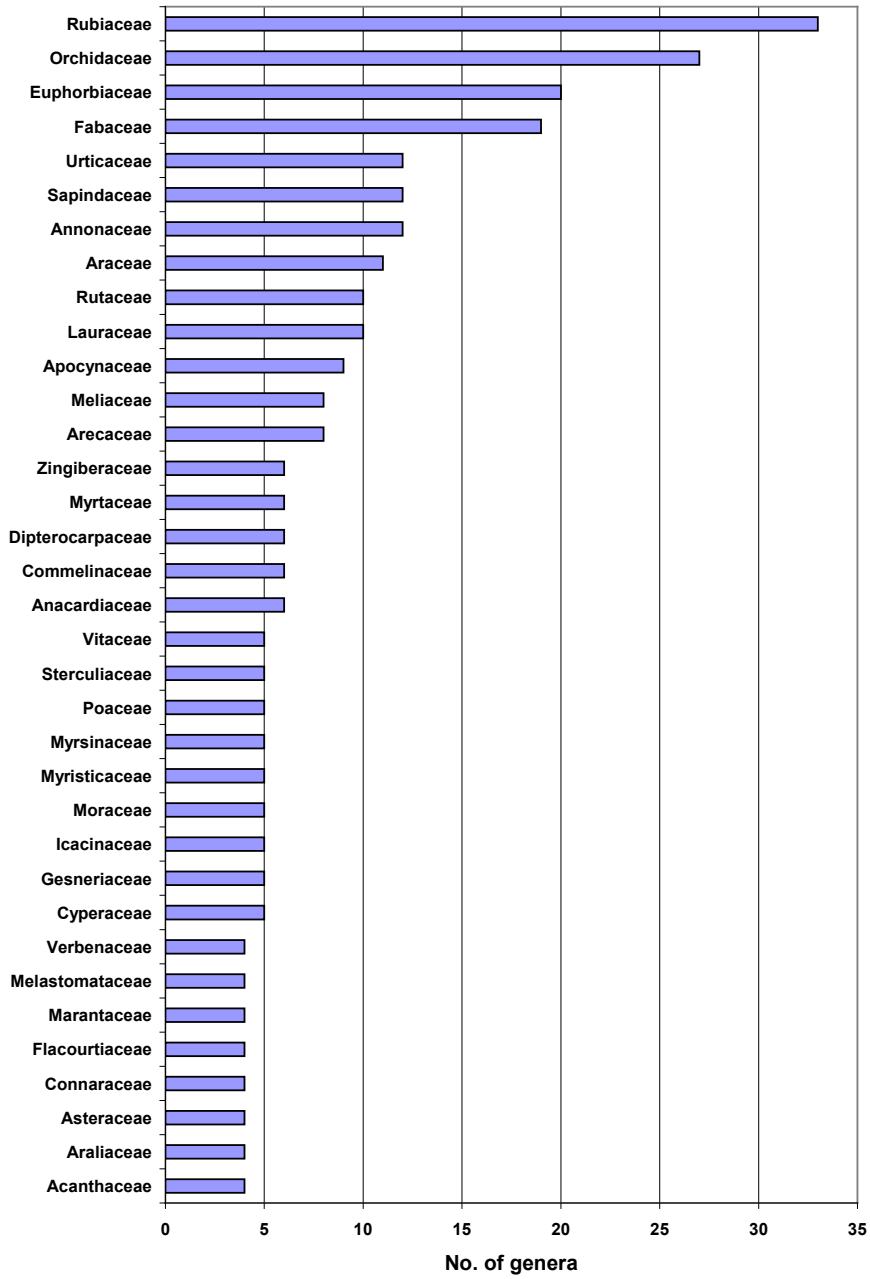

Figure 3. The most common spermatophyte families on Mt. Pangasugan, Leyte, Philippines, as based on the current status of floristic analysis

Table 4. Families and genera of spermatophytes identified on Mt. Pangasugan based on the synthesis of the studies by Po (2000), Belonias (2002), and Langenberger (2003)

Acanthaceae (4)*
Acanthus
Hemigraphis
Justicia
Strobilanthes

Aceraceae (1)
Acer

Actinidiaceae (1)
Saurauia

Alangiaceae (1)
Alangium

Amaranthaceae (2)
Achyranthes
Deeringia

Anacardiaceae (6)
Dracontomelon
Koordersiodendron
Mangifera
Rhus
Semecarpus
Spondias

Annonaceae (12)
Alphonsea
Anaxagorea
Artabotrys
Cananga
Cyathocalyx
Goniothalamus
Meiogyne
Papualthia
Platymitra
Polyalthia
Popowia
Uvaria

Apocynaceae (9)
Alstonia
Alyxia
Dischidia
Kibatalia
Lepiniopsis
Paralstonia
Tabernaemontana
Voacanga
Wrightia

Aquifoliaceae (1)
Ilex

Araceae (11)
Aglaonema
Alocasia
Amorphophallus
Costus
Homalomena
Pothoidium
(Araceae cont.)
Pothos
Raphidophora
Schismatoglottis
Scindapsus
Spadiphyllum

Araliaceae (4)
Arthrophyllum
Osmoxylon
Polyscias
Schefflera

Arecaceae (8)
Arenga
Calamus
Caryota
Daemonorops
Korthalsia

(Arecaceae cont.)
Oncosperma
Pinanga
Heterospathe

Aristolochiaceae (1)
Aristolochia

Asclepiadaceae (2)
Gymnema
Hoya

Asteraceae (4)
Ageratum
Blumea
Mikania
Vernonia

Balanophoraceae (1)
Balanophora

Begoniaceae (1)
Begonia

Bignoniaceae (2)
Oroxylum
Radermachera

Burseraceae (2)
Canarium
Dacryodes

Capparidaceae (1)
Capparis

Caprifoliaceae (2)
Sambucus
Viburnum

Table 4. Families and genera of spermatophytes identified on Mt. Pangasugan based on the synthesis of the studies by Po (2000), Belonias (2002), and Langenberger (2003) (cont.)

Casuarinaceae (1)
Gymnostoma

Cecropiaceae (2)
Poikilospermum
Procris

Celastraceae (3)
Bhesa
Euonymus
Lophopetalum

Chloranthaceae (2)
Chloranthus
Sarcandra

Chrysobalanaceae (1)
Maranthes

Clethraceae (1)
Clethra

Clusiaceae (3)
Calophyllum
Garcinia
Kayea

Combretaceae (1)
Terminalia

Commelinaceae (6)
Aneilema
Cyanotis
Floscope
Forrestia
Pollia
Rhopalephora

Connaraceae (4)
Cnestis
Connarus

(Connaraceae cont.)
Ellipanthus
Rourea

Crypteroniaceae (1)
Crypteronia

Cucurbitaceae (1)
Trichosanthes

Cunoniaceae (1)
Weinmannia

Cyperaceae (5)
Carex
Hypolytrum
Mapania
Paramapania
Scleria

Datiscaceae (1)
Octomeles

Dichapetalaceae (1)
Dichapetalum

Dilleniaceae (2)
Dillenia
Tetracera

Dioscoreaceae (2)
Dioscorea
Stenomeris

Dipterocarpaceae (6)
Anisoptera
Dipterocarpus
Hopea
Parashorea
Shorea
Vatica

Ebenaceae (1)
Diospyros

Elaeagnaceae (1)
Elaeagnus

Elaeocarpaceae (1)
Elaeocarpus

Ericaceae (2)
Rhododendron
Vaccinium

Euphorbiaceae (20)
Acalypha
Antidesma
Aporosa
Baccaurea
Breynia
Bridelia
Claoxylon
Cleidion
Cleistanthus
Codiaeum
Croton
Drypetes
Glochidion
Macaranga
Mallotus
Neotrewia
Omalanthus
Phyllanthus
Suregada
Trigonostemon

Fabaceae (19)
Albizia
Afzelia
Archidendron

Table 4. Families and genera of spermatophytes identified on Mt. Pangasugan based on the synthesis of the studies by Po (2000), Belonias (2002), and Langenberger (2003) (cont.)

(Fabaceae cont.)
Bauhinia
Dalbergia
Derris
Desmodium
Entada
Erythrina
Euchresta
Kingiodendron
Milletia
Mucuna
Ormosia
Pithecelobium
Pterocarpus
Spatholobus
Strongylodon
Wallaceodendron

Fagaceae (1)
Lithocarpus

Flacourtiaceae (4)
Casearia
Homalium
Osmelia
Trichadenia

Flagellariaceae (1)
Flagellaria

Gesneriaceae (5)
Aeschynanthus
Cyrtandra
Agalmyla
Monophyllaea
Rhynchoglossum

Gnetaceae (1)
Gnetum

Grossulariaceae (2)
Itea
Polyosma

Hamamelidaceae (1)
Sycopsis

Hernandiaceae (1)
Illigera

Hydrangeaceae (1)
Hydrangea

Icacinaceae (5)
Gomphandra
Gonocaryum
Miquelia
Phytocrine
Platea

Ixonanthaceae (1)
Ixonanthes

Juglandaceae (1)
Engelhardia

Lamiaceae (1)
Gomphostemma

Lauraceae (10)
Actinodaphne
Caryodaphnopsis
Cinnamomum
Cryptocarya
Dehaasia
Endiandra
Litsea
Neolitsea
Notaphoebe
Phoebe

Leeaceae (1)
Leea

Lecythidaceae (2)
Petersianthus
Planchonia

Liliaceae (2)
Curculigo
Dianella

Loganiaceae (3)
Fagraea
Geniostoma
Strychnos

Magnoliaceae (1)
Magnolia

Malpighiaceae (1)
Hiptage

Marantaceae (4)
Donax
Phacelophrynium
Phrynium
Stachyphrynium

Melastomataceae (4)
Astronia
Medinilla
Melastoma
Memecylon

Meliaceae (8)
Aglaia
Aphanamixis
Chisocheton
Dysoxylum
Reinwardtiodendron

Table 4. Families and genera of spermatophytes identified on Mt. Pangasugan based on the synthesis of the studies by Po (2000), Belonias (2002), and Langenberger (2003) (cont.)

(Meliaceae cont.)
Toona
Vavaea
Walsura

Menispermaceae (3)
Arcangelisia
Pycnarrhena
Tinomiscium

Monimiaceae (2)
Kibara
Matthaea

Moraceae (5)
Artocarpus
Ficus
Maclura
Trophis
Streblus

Musaceae (1)
Musa

Myristicaceae (5)
Endocomia
Gymnacranthera
Horsfieldia
Knema
Myristica

Myrsinaceae (5)
Ardisia
Discocalyx
Embelia
Maesa
Myrsine

Myrtaceae (6)
Acmena
Decaspermum
Syzygium
Tristaniopsis
Xanthomyrtus
Xanthostemon

Nepenthaceae (1)
Nepenthes

Ochnaceae (1)
Gomphia

Olacaceae (2)
Erythropalum
Strombosia

Oleaceae (1)
Olea

Opiliaceae (2)
Champereia
Melientha

Orchidaceae (27)
Acanthephippium
Aphyllorchis
Appendicula
Bulbophyllum
Calanthe
Ceratostylis
Coelogyne
Cymbidium
Dendrobium
Dendrochilum
Epigeneium
Eria
Erythrodes
Eulophia

(Orchidaceae cont.)
Flickingeria
Galeola
Grammatophyllum
Grastidium
Habenaria
Lepidogyne
Liparis
Luisia
Phalaenopsis
Plocoglottis
Robiquetia
Spathoglottis
Trichoglottis

Pandanaceae (2)
Freycinetia
Pandanus

Pentaphragmataceae (1)
Pentaphragma

Piperaceae (2)
Peperomia
Piper

Pittosporaceae (1)
Pittosporum

Poaceae (5)
Bambusa
Centotheca
Dinochloa
Schizostachyum
Thysanonlaena

Podocarpaceae (1)
Podocarpus

Table 4. Families and genera of spermatophytes identified on Mt. Pangasugan based on the synthesis of the studies by Po (2000), Belonias (2002), and Langenberger (2003) (cont.)

Polygalaceae (2)
Polygala
Xanthophyllum

Proteaceae (1)
Helicia

Ranunculaceae (1)
Clematis

Rhamnaceae (3)
Sageretia
Ventilago
Ziziphus

Rhizophoraceae (1)
Gynotroches

Rosaceae (2)
Prunus
Rubus

Rubiaceae (33)
Adina
Argostemma
Boholia
Borreria
Canthium
Diodia
Diplospora
Dolicholobium
Gardenia
Greeniopsis
Hedyotis
Hydnophytum
Hypobathrum
Ixora
Lasianthus
Morinda

(Rubiaceae cont.)
Mussaenda
Mycetia
Myrmecodia
Nauclea
Neonauclea
Ophiorrhiza
Pavetta
Pertusadina
Praravinia
Psychotria
Tarenna
Tarrenoidea
Timonius
Uncaria
Urophyllum
Wendlandia
Xanthophytum

Rutaceae (10)
Achronychia
Atalantia
Clausena
Euodia
Glycosmis
Lunasia
Melicope
Micromelum
Severinia
Zanthoxylum

Sabiaceae (1)
Meliosma

Sapindaceae (12)
Allophylus
Cubilia
Dictyoneura
Dimocarpus
Euphorianthus
Ganophyllum

(Sapindaceae cont.)
Guioa
Harpullia
Lepisanthes
Nephelium
Paranephelium
Pometia

Sapotaceae (3)
Palaquium
Planchonella
Pouteria

Saxifragaceae (2)
Dichroa
Polyosma

Simaroubaceae (1)
Picrasma

Smilacaceae (1)
Smilax

Solanaceae (1)
Solanum

Sonneratiaceae (1)
Duabanga

Staphyleaceae (1)
Turpinia

Sterculiaceae (5)
Heritiera
Melochia
Pterocymbium
Pterospermum
Sterculia

Symplocaceae (1)
Symplocos

Annex 1: Families and genera of spermatophytes identified on Mt. Pangasugan based on the synthesis of the studies by Po (2000), Belonias (2002), and Langenberger (2003) (cont.)

Taccaceae (1)
Tacca

Theaceae (2)
Eurya
Ternstroemia

Thymelaeaceae (3)
Aquilaria
Gonystylus
Phaleria

Tiliaceae (3)
Colona
Grewia
Microcos

Ulmaceae (3)
Celtis
Gironniera
Trema

Urticaceae (12)
Cypholophus
Dendrocnide

(Urticaceae cont.)
Elatostema
Elatostematoides
Girardinia
Laportea
Leucosyke
Maoutia
Oreocnide
Pilea
Pipturus
Pouzolzia

Verbenaceae (4)
Clerodendrum
Premna
Teijsmanniodendron
Vitex

Vitaceae (5)
Ampelocissus
Cayratia
Cissus
Pterisanthes
Tetrastigma

Winteraceae (1)
Drimiys

Zingiberaceae (6)
Adelmeria
Alpinia
Globba
Kolowratia
Languas
Plagiostachys

* The application of family and genus names has been standardized based on Gunn et al. (1992).
The numbers in brackets refer to the number of genera so far identified within the respective families.

Table 5. Families and genera of pteridophytes identified on Mt. Pangasugan based on the synthesis of the studies by Belonias and Bañoc (1994) and Langenberger (2003)*

Aspidiaceae
Ctenitis
Cyclopeltis
Heterogonium
Pleocnemia
Pteridrys
Tectaria

Aspleniaceae
Asplenium

Athyriaceae
Diplazium

Blechnaceae
Blechnum
Stenochlaena

Cyatheaceae
Cyathea

Davalliaceae
Davallia
Trogostolon

Dennstaedtiaceae
Dennstaedtia
Microlepia

Dryopteridaceae
Didymochlaena

Table 5. Families and genera of pteridophytes identified on Mt. Pangasugan based on the synthesis of the studies by Belonias and Bañoc (1994) and Langenberger (2003)*

Gleicheniaceae
Dicranopteris
Gleichenia

Grammitidaceae
Calymmodon
Scleroglossum

Hymenophyllaceae
Trichomanes
Hymenophyllum

Lindsaeaceae
Lindsaea
Sphenomeris
Tapeinidium

Lycopodiaceae
Lycopodium

Lomariopsidaceae
Bolbitis
Elaphoglossum
Lomogramma
Teratophyllum

Marattiaceae
Angiopteris
Marattia

Oleandraceae
Nephrolepis
Oleandra

Osmundaceae
Osmunda

Parkeriaceae
Ceratopteris

Polypodiaceae
Colysis
Drynaria
Leptochilus
Microsorum
Pyrrosia
Selliguea

Psilotaceae
Psilotum

Pteridaceae
Acrostichum
Pteris

Salviniaceae
Azolla
Salvinia

Schizaeaceae
Lygodium

Selaginellaceae
Selaginella

Sinopteridaceae
Adiantum
Pytyrogramma
Syngramma
Taenitis

Thelypteridaceae
Amphineuron
Chingia
Christella
Cyclosorus
Macrothelypteris
Pneumatopteris
Pronephrium
Pseudophegopteris
Sphaerostephanos

Vittariaceae
Antrophyum
Vittaria

* The study by Belonias and Bañoc (1994) includes lowland aquatic (cultivated) habitats, therefore aquatic ferns are included. The list also includes taxa observed during recent field work in mossy forest, e.g. *Elaphoglossum* and *Calymmodon.* The application of family and genus names has been standardized using the checklist on Philippine ferns by Salgado (1990).

Table 6. Classes and genera of bryophytes identified in the foothills of Mt. Pangasugan (from Quimio, 1994)

Class Musci	**Class Hepaticae**	**Class Anthocerotae**
Acroporium	*Aneura*	*Anthoceros*
Anomobryum	*Apometzgeria*	
Barbula	*Apotreubia*	
Bryum	*Bazzania*	
Buxbaumia	*Blasia*	
Calymperes	*Cyathodium*	
Calytothecium	*Frullania*	
Campylopus	*Lejeunea*	
Clastrobryum	*Lophocolea*	
Dicranella	*Marchantia*	
Dicranoloma	*Metzgeria*	
Fissidens	*Pellia*	
Hypnum	*Riccia*	
Macromitrium		
Macromitrium		
Neckeropsis		
Neckeropsis		
Orthodontium		
Orthotrichum		
Plagiopus		
Ptychomitrium		
Symphysodontella		
Taxithellium		
Zygodon		

description (GL 3467, 3677, 3678, 3695) (David Frodin, pers. comm.). One *Lasianthus* (Rubiaceae) specimen (GL 3440) might represent a new species (Zhu Hua, pers. comm.). Many other taxa have never been recorded for Leyte or are even described as endemic to restricted areas elsewhere in the Philippines. Many rare or even new species might still be hidden in the large pile of backlog specimens and morphospecies stored at the VSU Herbarium.

Besides the encounter and documentation of rare or new species a better knowledge of the Leyte flora will also allow new insights in the geographic distribution of taxa and thus in the plant-geographic development of the Philippine archipelago. We are therefore convinced

that Mt. Pangasugan and the Leyte Cordillera deserve more attention. Although the Herbarium of the Visayas State University suffers a low budget - as it is typical not only for many tropical Herbaria - it is well equipped and provides good working facilities at the foot of a fascinating mountain.

ACKNOWLEDGEMENTS

The authors wish to especially thank the following: Ms. Jannes Detablan and Ms. Marie Macanas for their assistance in the processing of backlog specimens and encoding of the Herbarium data; and the various researchers and students who have worked on the flora of Mt. Pangasugan. Additionally, many of the taxa provided in Annex 1 could be added as a result of a research grant to the first author by the A.F.W. Schimper Foundation, Hohenheim, Germany.

REFERENCES

ASIO, V. 1996. *Characteristics, Weathering, Formation and Degradation of Soils from Volcanic Rocks in Leyte, Philippines.* Hohenheimer Bodenkundliche Hefte 33, Univ. Hohenheim, Stuttgart, Germany. 209 pp.

BELONIAS, B. S. 2002. *The dicot flora on the western slopes of Mt. Pangasugan, Leyte Island, Philippines.* PhD Thesis, University of the Philippines, Los Banos, Philippines. 133 pp.

BELONIAS, B. S. and L. M. BAÑOC. 1994. Species diversity and distribution of pteridophytes in Mt. Pangasugan, Leyte, Philippines. *Annals of Tropical Research* **16(2)**:30-38.

DENR and UNEP. 1997. *Philippine Biodiversity: An Assessment and Action Plan.* Bookmark Inc., Makati City, The Philippines. 298 pp.

DICKERSON, R. E. 1928. *Distribution of Life in the Philippines,* Reprinted 1975, The Bookmark Inc., Manila. 322 pp + figures.

FESSEL, H. H. and LUECKEL. 1996a. Dendrobium milaniae. *Die Orchidee* **47(3)**:A131.

FESSEL, H. H. and LUECKEL. 1996a. Flickingeria junctilobia. *Die Orchidee* **49(5)**:251.

FESSEL, H. H. and LUECKEL. 1996b. Dendrobium orbilobulatum. *Die Orchidee* **47(5)**: A232.

FESSEL, H. H. and LUECKEL. 1997. Dendrobium balzerianum. *Die Orchidee* **48(4)**:173.

FRODIN, D. G. 2001. *Guide to Standard Floras of the World, 2nd ed.* Cambridge University Press, Cambridge. 1100 pp.

GUNN, C. R., J. H. WIERSEMA, C. A. RITCHIE, and J. H. KIRKBRIDE JR. 1992. *Families and Genera of Spermatophytes Recognized by the Agricultural Research Service*. U.S. Department of Agriculture, Technical Bulletin No 1796. 500 pp.

KARTAWINATA, K. 1990. A review of natural vegetation studies in Malesia, with special reference to Indonesia. In: *The Plant Diversity of Malesia. Proceedings of the Flora Malesiana Symposium, Leiden* (P. Baas, K. Kalkman, and R. Geesink, eds). August 1989. Kluwer Academic Publishers, The Netherlands, pp. 120-132.

KINTANAR, R. L. 1984. *Climate of the Philippines*. PAGASA, Quezon City, Philippines, September 1984, 38 pp.

LANGENBERGER, G. 2003. *Diversität, Struktur und Reliefabhängigkeit der Vegetation in einem Tieflandregenwald der Insel Leyte,*

Philippinen. Dissertation. Institute of Plant Production and Agroecology in the Tropics and Subtropics (380), University of Hohenheim. 181 pp.

MADULID, D. A. and M. G. AGOO. 1992. *A bibliography on Philippine Biodiversity: Part I - Plants*. National Museum, Manila, Philippines. 189 pp.

MERRILL, E. D. 1945. *Plant life of the Pacific world*. The Macmillan Company, New York, US. 295 pp.

MYERS, N., R. A. MITTERMEIER, C. G. MITTERMEIER, G. A. B. DA FONSECA, and J. KENT. 2000. Biodiversity hotspots for conservation priorities. *Nature* **403**:853-858.

ONG, P. S., L. E. AFUANG, and R. G. ROSELL-AMBAL. 2002. *Philippine biodiversity conservation priorities: a second iteration of the National Biodiversity Strategy and Action Plan.* DENR-PAWB, Conservation International Philippines, Biodiversity Conservation Program-University of the Philippines Center for Integrative and Development Studies, and Foundation for the Philippine Environment, Quezon City, Philippines. 113 pp.

PO, P. 2000. *Altitudinal distribution, diversity and abundance of the monocotyledonous flora of Mt. Pangasugan, Leyte.* M.S. Thesis, University of the Philippines, Los Baños, Laguna, Philippines.

QUIMIO, C. A. 1994. Bryophytes of river valleys and kaingin areas of Mt. Pangasugan, Leyte, Philippines. *Annals of Tropical Research* **16(2)**:39-45.

PRANCE, G. T., H. BEENTJE, J. DRANSFIELD, and R. JOHNS. 2000. The Tropical flora remains undercollected. *Ann. Missouri Bot. Gard.* **87**:67-71.

SALGADO, A. E. 1990. A checklist of Philippine ferns. *Philipp. J. Sci.* **119(2)**:107-148.

SOERIANEGARA, I. and R.H.M.J. LEMMENS. 1994. *Plant Resources of South-Est Asia No. 5(1): Timber Trees: Major commercial timbers.* Prosea Foundation, Bogor, Indonesia & Pudoc-DLO, Wageningen, the Netherlands. 610 pp.

VAN STEENIS, C. G. G. J. 1950. Chronology of the collections. Pp. LXXVI-CVI. In: *Flora Malesiana Series I, Vol. 1.* (C. G. G. J. van Steenis, ed).

ZIKELI, S. 1998. *Nutrient status and nutrient cycles of the tropical rainforest, Mt. Pangasugan, Leyte, Philippines.* Diplomarbeit, Landwirtschaftliche Fakultät, Inst. f. Bodenkunde u. Pflanzenernährung, Martin-Luther-Universität Halle-Wittenberg. 101 S.