

**BAUHINIA L. IN THE PHILIPPINE ISLANDS:
ASPECTS OF DIVERSITY AND VEGETATION UNITS**

***Bauhinia* L. aux Philippines :
aspects de la diversité et des unités de végétation**

S. RUELLE* & F. MALAISSE**

RESUME

Quatorze espèces de Bauhinia L. (Caesalpiaceae) ont été recoltées aux Philippines en 1997 au cours d'une mission d'étude, dont six sont indigènes. Leurs milieux respectifs, ainsi que la composition floristique des écosystèmes qui les accueillent, ont été étudiés. Ces résultats sont présentés et discutés.

ABSTRACT

Among 14 species of Bauhinia L. (Leguminosae – Caesalpinioideae) collected in 1997 in the Philippine Islands during a survey, six are indigenous. Their respective habits, as well as their plant communities, were studied. These results are presented and discussed.

INTRODUCTION

Beside exotic *Bauhinia* species, often introduced along roads and in cities' parks as ornamental plant according to their beautiful coloured flowers, most of Philippine *Bauhinia* species belongs to the Indo-Malayan floral geo-element. From more than 70 species quoted in Southeast Asia, some 14 have been collected and observed during a survey carried out in 1997. Nevertheless the majority of studied indigenous species

* Laboratoire d'Ecologie, Faculté Universitaire des Sciences Agronomiques, Passage des Déportés, n°2, B-5030, Gembloux, Belgium. E-mail : ruelle.s@fsagx.ac.be

** Jardin Botanique National de Belgique, Domaine de Bouchout, B-1860, Meise, Belgium. E-mail : malaisse@br.fgov.be

even if they are present in the Philippines, have their origin centre located outside of the country.

Our prospecting is mostly located on two large islands of the Philippines, Luzon in the North and Palawan in the West. In the field, six study sites have been chosen, they are distributed in several provinces namely Isabela Province (North of Luzon), Nueva Ecija Province (North of Luzon), Central and South Provinces of Palawan (Fig. 1).

MATERIAL ET METHODS

Each site is distinguished by three features : general, edaphic and specific ones. Field charts (Tab. I) are systematically elaborated regarding those three levels. As regards general characterisation, allowing first approach of the environment, ten observation features are defined, namely : elevation, landscape type, vegetation density, occurrence or absence of relief lines, presence of waterway and its qualification, site exposition, vegetation type, environment complexity and dominant species. Soil are defined according to five features: pH, occurrence of organic material and its abundance, texture, colour, stone charge. Each species of *Bauhinia* encountered in the environment is described and its population evaluated.

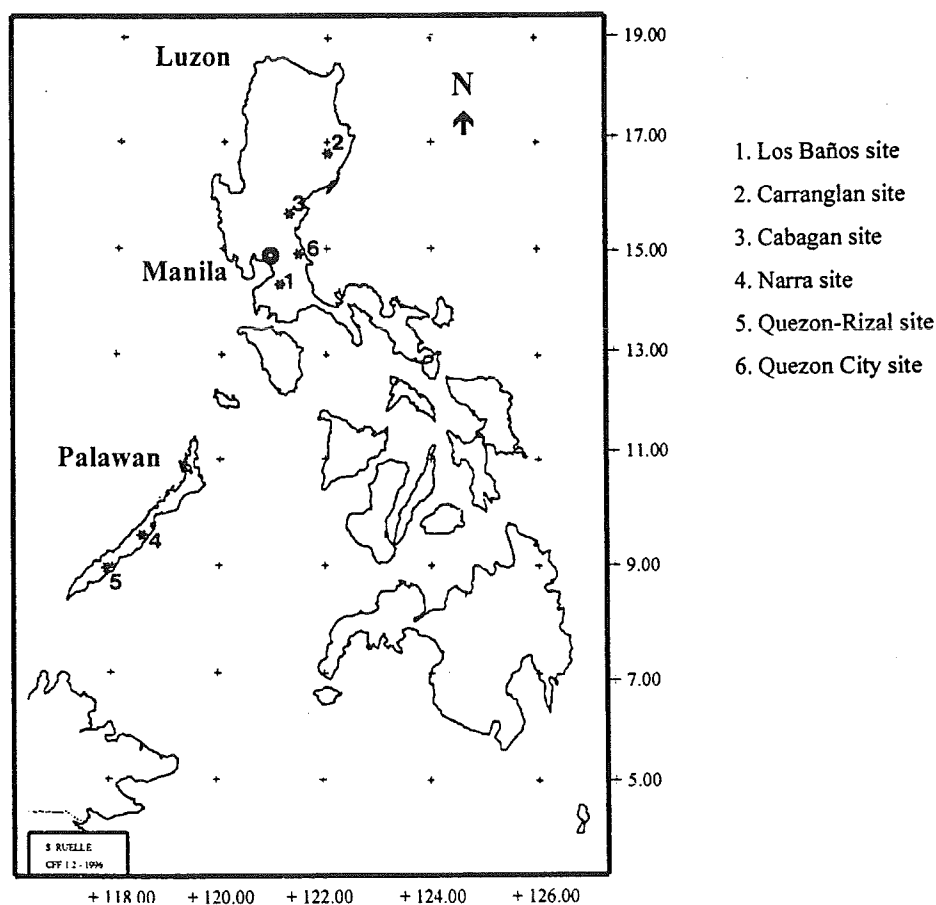


Fig.1. – Study sites on the Philippine Islands map

A phytosociological survey is produced for each study site having recourse to three coefficients : Braun-Blanquet abundance factor, Vanden Bergen abundance-dominance factor and a sociability factor. Those coefficients are attributed to each species presented in its environment. Other observations such as forest layer, phenology, health and mean height are also carried out.

Determination of minimal area needed for accurate observations resulted from quadrat method. Indeed, from basic initial quadrat deliberately confined to 50 x 50 cm, we have evolved to a more wider surface, by doubling the area until the surface-species number curve reaches an asymptotic way. Consequently, observations on each site were not obtained from a same minimal area according to local site's plant diversity and distribution.

RESULTS

PRELIMINARY RESULTS

Our survey allows to examine 14 species in the field. These are : *Bauhinia acuminata* L., *B. binata* Blanco, *B. excelsa* (Miq.) Prain var. *aurora* (de Wit) K. & S.S. Larsen, *B. excelsa* (Miq.) Prain var. *excelsa*, *B. foraminifer* Gagnep. var. *falcata* K. & S.S. Larsen, *B. galpinii* N.E.Br., *B. integrifolia* Roxb. subsp. *cumingiana* (Benth.) K. & S.S. Larsen var. *cumingiana*, *B. malabarica* Roxb., *B. merilliana* Perkins var. *merilliana*, *B. monandra* Kurz, *B. purpurea* L., *B. semibifida* Roxb. var. *perkinsae* (Merr.) K. & S.S. Larsen, *B. tomentosa* L., *B. variegata* L.

SITES AND SPECIES

Only species with no ornamental use will be described in this part. Among the 14 species collected, 6 are indigenous : *Bauhinia integrifolia* subsp. *cumingiana* var. *cumingiana*, *B. excelsa* var. *excelsa*, *B. semibifida* var. *perkinsae*, *B. merilliana* var. *merilliana*, *B. foraminifer* var. *falcata* and *B. malabarica* are concerned. From a morphological point of view, species belonging to the genus *Bauhinia* present an important diversity. These concern the habit (trees, shrubs (sometimes semiscandent), or liana with (rarely without) simple tendrils) as well as leaf morphology (leaves are entire, 2-lobate, or 2-foliolate, midrib with weakly to strongly developed secondary veins), prickliness (unarmed or with intrastipular spines -rarely shrubs with tendrils or thorns-), stipules diversity (deciduous or persistent, with or without intrastipular trichomes variously developed, sometimes adpetiolarly enlarged and forming a spine), flower organization (flowers are solitary or few to many in terminal or subterminal and axillary racemes, corymbs, or panicles, bisexual or rarely unisexual (polygamous or dioecious), petals (1-)5(-6) are white with various shades of red to purple, or yellow, subequal to greatly unequal), and fruit's morphology (fruits are flat, suborbicular to broadly elliptic or obovate to linear, woody or thinvalved, dehiscent -often explosively- or indehiscent, continuous, filled, or septate [K. & S. S. Larsen, 1996]). This enable us to understand reasons for systematic richness into this genus (Tab. II).

In the present paper we succinctly consider environment and present a short description of the species involved. Two transect site will be presented and described. A special attention will be payed to *Bauhinia malabarica* as an example of full investigation.

Bauhinia malabarica Roxb

a.-. Taxonomic description

This species is a dioecious tree sometimes up to 15 m tall, young branches are pubescent. Stipules are linear, dropping off very early and petiole glabrous to pubescent. The lamina is ovate to rotundate, bifide with wide sinus, tips of lobes are rounded. The upper surface of leaf is light green, sparsely pubescent, the below surface is glaucous (greyish white when dry). Inflorescences are short, simple or few-branched racemes from the leaf axis. Bracts are very small and triangular. The petals are cream coloured. Male flowers content 10 fertile stamens shorter than petals length, female flowers content 10 staminodes with densely tomentose ovary. Pods are indehiscent, silky and strap-shaped, often terminated by a long, straight beak, the surface being finely striate. Seeds are included inside a silky down.

b.-. Study site and vegetation units

The study site is situated in Nueva Ecija Province (North Luzon). Two stations were studied but they present a same ecological aspects. The landscape is characterised by dry hills of low elevation. The main vegetal formation is a dry savanna composed of three variants. *Bauhinia malabarica* dominates the floristic environment and quickly expands without any constraints of the site. The field chart of Carranglan site is presented below (Tab. I). Three elements are observed : (1) a topographical and general preview of the site, (2) some features involving soil description and (3) a quick description of the species. On the Carrangan site, we have observed a low elevation (370 m), a very small water point at the bottom of the vegetal formation (in response to a few meters level change (3 m) and the minimal quadrat needed for herbaceous phytosociological survey is only 4 x 8 metres.

The phytosociological survey (Tab. II) carries out dominant species belonging to bush level like *Bauhinia malabarica* or to herbaceous level like *Imperata cylindrica* (L.) Beauv. (Poaceae) or *Themeda arguens* (L.) Hack. (Poaceae). Thanks to a ground plan (Fig. 2), we are able to distinguish three vegetation units, namely : (1) a *Dichantium annulatum* (Forsk.) Stapf (Poaceae) wet herbaceous savanna, (2) a *Bauhinia malabarica* and *Vitex parviflora* Juss. (Verbenaceae) shrub savanna and (3) a *Themeda triandra* Forsk. (Poaceae) and *Helicteres augustifolia* L. (Sterculiaceae) dry herbaceous savanna restricted to hillside.

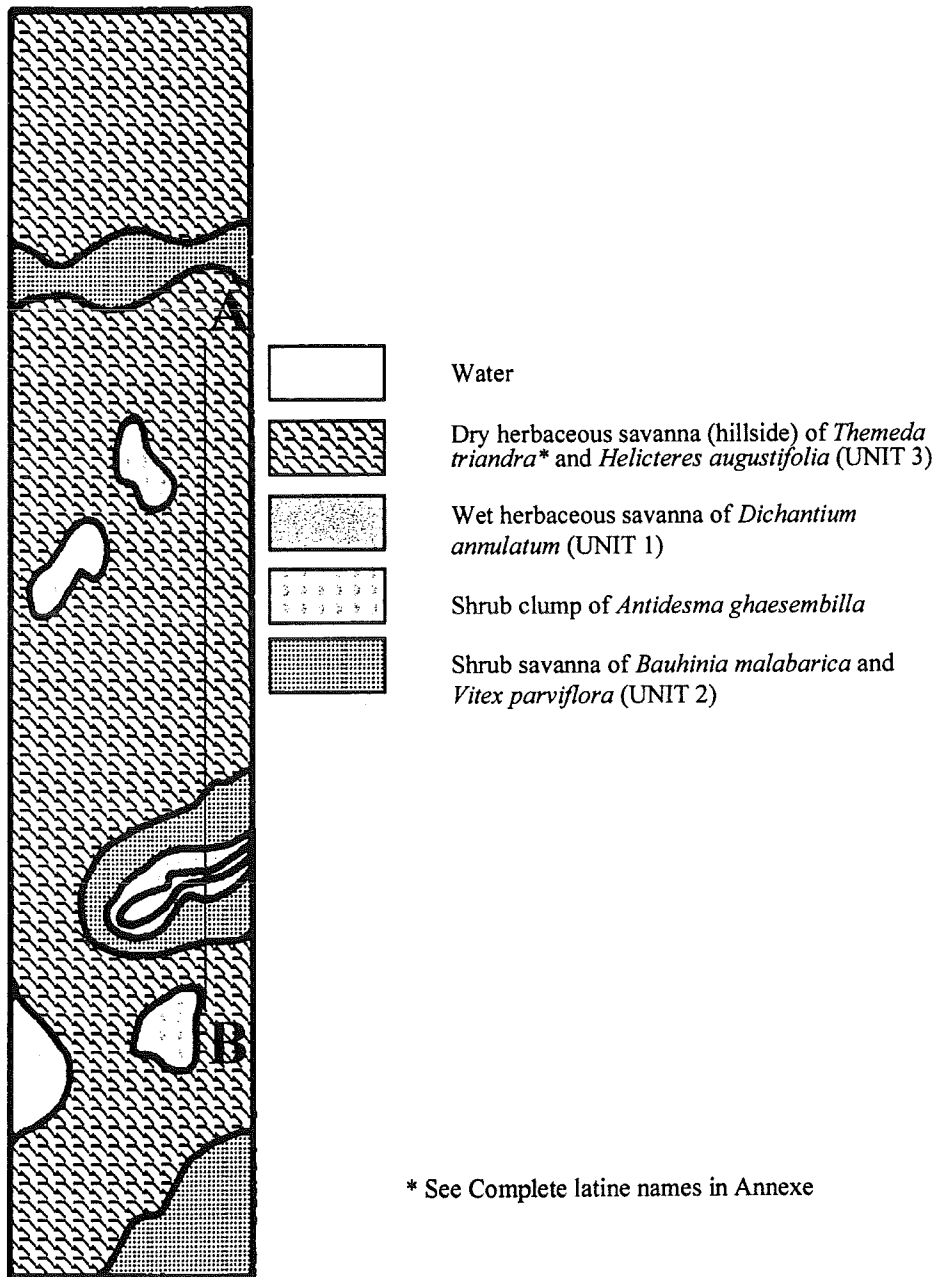


Fig.2. - Ground plan of vegetation units on Carranglan site

Tab.I. - Field chart of Carranglan site (*Bauhinia malabarica*)

Site : CR ST2	
1. Generalities	
Elevation	370 m
Relief	ondulating gently hills
Ridge lines	none
Direction	valley perpendicular to N-S direction
Water points	small stagnant rainwater
Vegetation extend	very important
Vegetation type	bushed grassland – herbaceous savanna
Vegetation complexity	low
Dominant species	<i>Bauhinia malabarica</i> (Caesalp.), <i>Capillipedium parviflorum</i> (Poac.), <i>Imperata cylindrica</i> (Poac.)
Miscellaneous	dry environment
2. Soil	
pH	4,5
Organic material	++
Texture	clayey and sticky
Color	light brown
Stony charge	middle
3. Bauhinia	
Species	<i>malabarica</i>
Population extend	highest , dominant
Observations	thick leaves, many linear pubescent pods, above 6 m tall

A transect of the Carranglan site (Fig. 3) allow us to make a good visualization of vegetation aspect. We noticed that this environment, even if it looks like a dryer place, contains a large panel of species belonging to diverse families. It's mainly *Bauhinia malabarica* that creates the vegetal facies of this site. However, herb layer plays an huge part of the vegetal unit and is also composed by voluble herbs.

Bauhinia integrifolia* subsp. *cumingiana* var. *cumingiana

a.-. Taxonomic description

This variety is a liana, distinguished by ovoid to ellipsoid buds, filaments shorter than petals, hairy style. Leaves are always deeply bifid with glabrescent undersides and lobes are obtuse to acuminate. At the species taxonomic level, inflorescences are multiflowered, with dense panicles made up of corymbose racemes and unequal petals orange turning red.

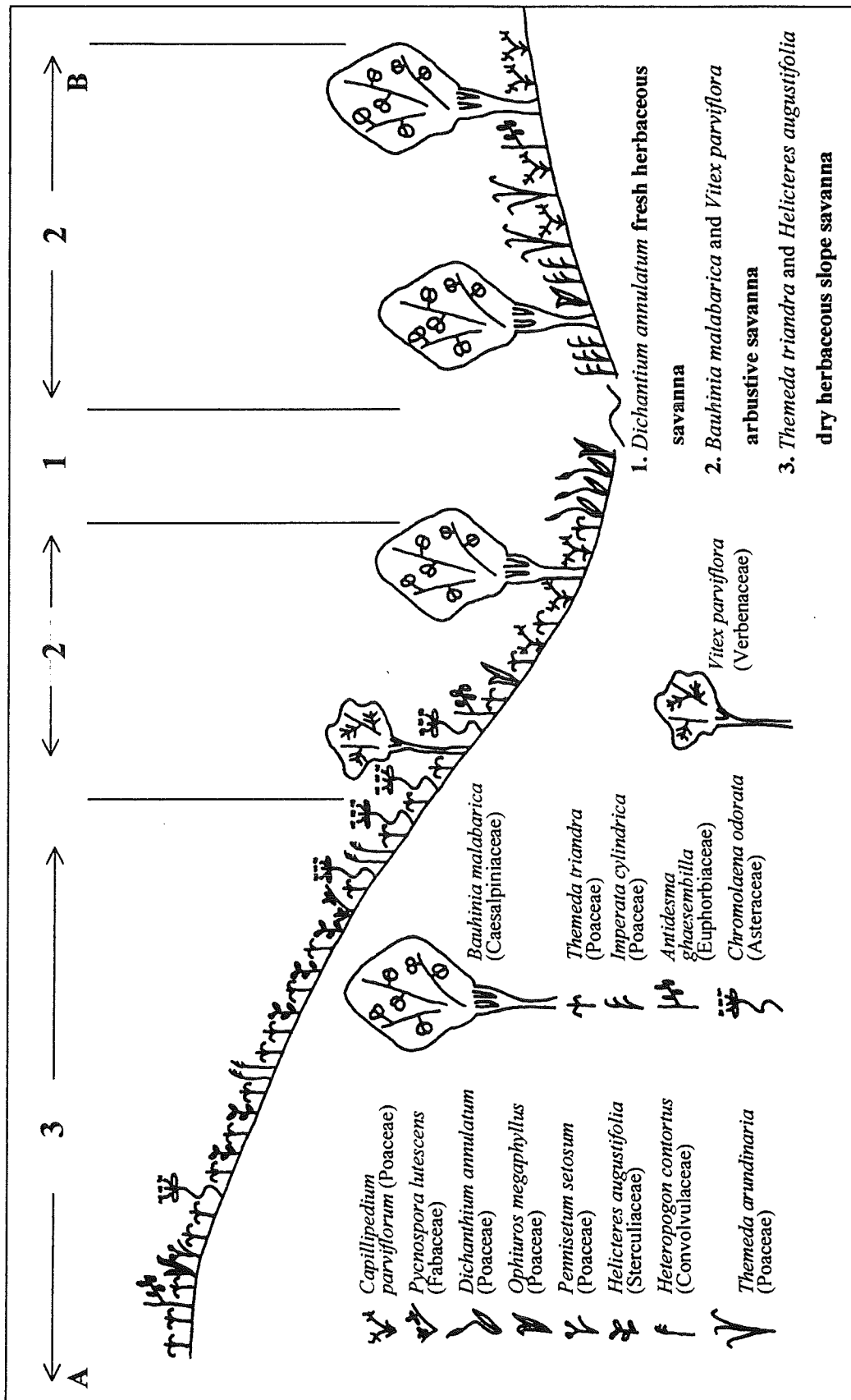


Fig.3. - Carranglan site transect

Tab. II. - Phytosociological survey of Carrangan site : Ph = Phenology (V : Vegetative, F : Flower, Fr : Fruit); L = Vegetation Layer (h : herbaceous, s : shrub, T : Tree); He = Health Level (G : Good, M : medium); MH = Mean Height; A = Abundance coefficient; A-D = Abundance-Dominance coefficient; S = Sociability coefficient.

Species (Family)	Ph	L	He	MH (m)	A	A-D	S
<i>Antidesma ghaesembilla</i> (Euphorbiaceae)	V	T	G	2.5	1	+	1
<i>Bridelia stipularis</i> (Euphorbiaceae)	V	T	M	1.5	1	+	1
<i>Capillipedium parviflorum</i> (Poaceae)	F	h	G	1	5	4	2
<i>Chromolaena odorata</i> (Asteraceae)	F	h	G	1	2	1	1
<i>Cissus</i> sp. (Vitaceae)	V	h	G	Liana	1	+	1
<i>Elephantopus mollis</i> (Asteraceae)	F	h	G	1	3	1	1
<i>Heteropogon contortus</i> (Poaceae)	F	h	G	1.5	2	1	1
<i>Imperata cylindrica</i> (Poaceae)	V	h	G	1	4	2	2
<i>Merremia hirta</i> (Convolvulaceae)	Fr	h	G	Liana	1	+	1
<i>Neonauclea</i> sp. (Rubiaceae)	V	T	G	4	1	+	1
<i>Ophiuros megaphyllus</i> (Poaceae)	V	h	G	2	2	1	1
<i>Pittosporum pentandrum</i> (Pittosporaceae)	V	T	G	3	1	+	1
<i>Psidium guajava</i> (Myrtaceae)	V	s	G	1	1	+	1
<i>Smilax elmeri</i> (Smilacaceae)	V	h	G	Liana	1	+	1
<i>Triumfetta bartramia</i> (Tiliaceae)	V	s	G	1	2	+	1
<i>Vitex parviflora</i> (Verbenaceae)	V	T	G	2	1	+	1

b.-. Study site and vegetation units

The study sites localized in Isabela Province are mostly herbaceous hills of low elevation (180 m). The species occurs in true woody vegetation patches, often in humid situations; it spreads out in sunny sites and colonized most of gallery forest. Minimal quadrat is of 32 x 32 m. Because of the local environment opening, dominant species are to be found in the grass layer, namely *Imperata cylindrica* (L.) Beauv. (Poaceae), *Mimosa pudica* L. (Mimosaceae) and *Evolvulus alsinoides* L. (Convolvulaceae).

If we observed the site transect regarding this species (Fig. 4), the dry environment of the phytocenose is really obvious. We have a high pressure of the grass layer. Indeed, most of the present species on this site belongs to Poaceae or Cyperaceae families. We are therefore in a dry surroundings highly similar to dry herbaceous savanna.

Bauhinia excelsa var. excelsa

a.-. Taxonomic description

This taxon is a liana, distinguished by leaves glabrescent below when adult and by ellipsoid-clavate buds. At species level, buds are large, stamens 2 (-3) fertiles with purple filament and red anthers, leaves are ovate, bilobed with glabrous upper side and hairy underside, inflorescences are terminal or lateral right racemes and petals cream coloured becoming yellow after fecondation.

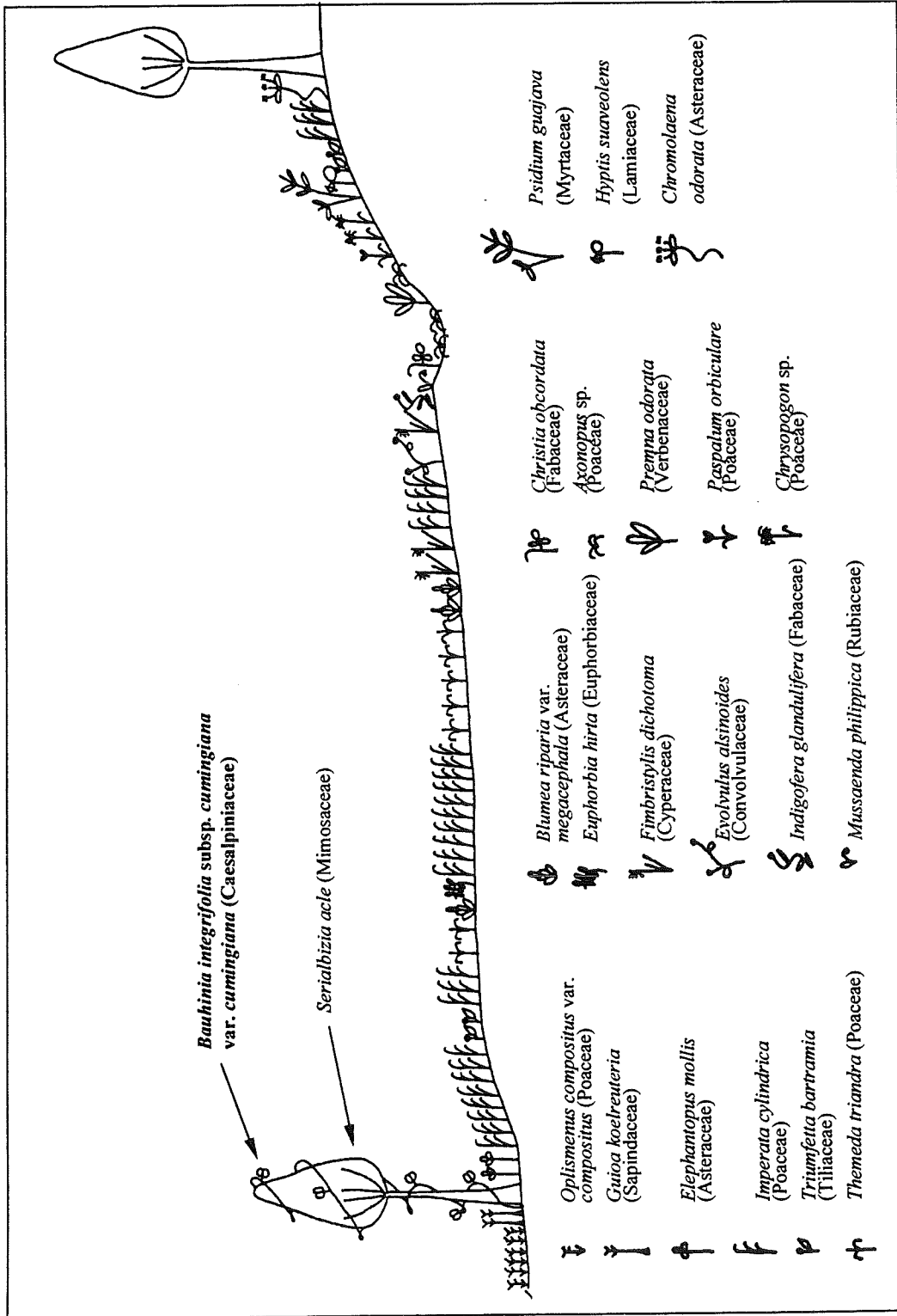


Fig. 4. - Cabagan site transect

b.-.Study site and vegetation units

The study site is located in Central Province of Palawan island. It is a coastal plain, few kilometres wide, next central mountains of the island. Anthropoc pressure is quite important in this area, but there are some virginal environments as the one where our research was carried out. The environment is open and invaded by many lianas species. Dominant species are shrubs, often endemic of the island, as *Languas foxworthyi* (Ridl.) Merr. (Zingiberaceae).

Bauhinia semibifida* var. *perkinsae

a.-. Taxonomic description

This variety is a liana where leaves content lobes obtuse to acuminate. Tendrils are present and white shades are observed along uperside leave veins, leave underside is purple. The petiol is thin and inflorescences in corymbes to racemes content many small flowers. Inequal petals are firstly white and become yellow after fecondation. The pods are linear shape and glabrous.

b.-. Study site and vegetation units : see B. excelsa.

Bauhinia merilliana* var. *merilliana

a.-. Taxonomic description

This variety is a liana tendrilled climber, young branches are ferrugineous pubescent, later glabrous. The lamina is broadly ovate-oblong to orbicular and bifid. The inflorescences are many flowered terminal racemes. The buds are ellipsoid to apiculate with ferrugineous hairs. The petals are white turning yellowish to orange. The flower is characterised by three fertile stamens and a purple filament.

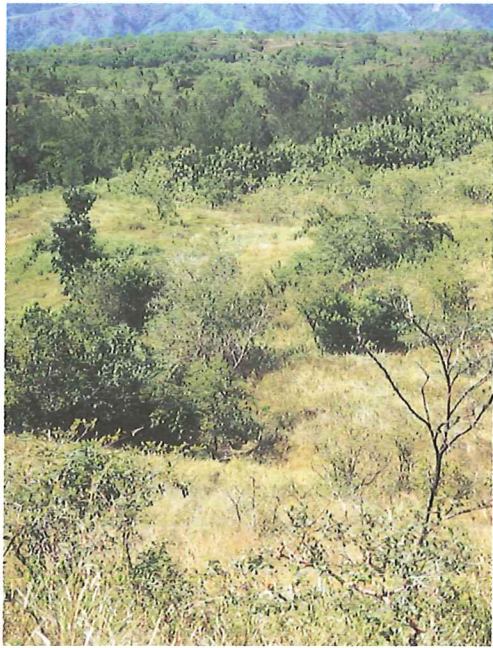
b.-. Study site and vegetation units

The study site is located in Central Province of Palawan island. This is a coastal hill near the ocean, the elevation is low (130 m). The environment is composed by a complex vegetation close to a waterway. Many lianescent species are well developed in superior level of the vegetation. The dominant species is a bamboo tree (*Cephalostachyum mindorense* Gambe (Poaceae).

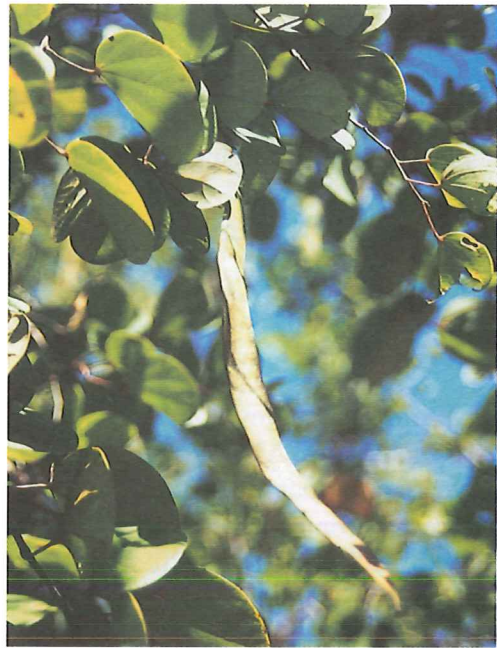
Bauhinia foraminifer* var. *falcata

a.-. Taxonomic description

This species is a liana tendrilled climber, young shoots are slender, glabrous with short tendrils. Leaflets are falcate with tips acute to acuminate, but distinguished by the densely silky reddish brown indumentum on the lower side of the young leaflets.



A.



B.



C.



D.



E.



F.

Fig.5. - Site aspect and *Bauhinia* diversity: A. Carranglan site (North Luzon); B. *B. malabarica* pods; C. *B. merilliana* var. *merilliana* inflorescences; D. Two-coloured leaf sides of *B. semibifida* var. *perkinsae*; E; Two coloured flowers of *B. excelsa* var *excelsa* inflorescences; F. *B. integrifolia* subsp. *cumingiana* var. *cumingiana* pods and inflorescences

The lamina is deeply bilobed or even bifoliolate. The inflorescences are lateral and terminal corymbs with triangular bracts. Petals are white, lanceolate to obovate.

b.-. Study site and vegetation units : see B. merilliana

DISCUSSION

From our survey and taking into account the quite large diversity of *Bauhinia* genus in general (WATSON & DALLWITZ, 1983), and in the Philippines in particular, we can carry out that most of the studying species (Fig. 5) were well established on their respective environment. In a second way, this genus is tough because of its incredible capacity of adaptation to different kind of environment aggressions. However, in a general way, the woody indigenous *Bauhinia* species of Philippines are mostly located in dry ecosystems and even in dry savanna vegetation units. On the other hand, liana species (PUTZ & MOOHEY, 1991), woody or not, often appear inside wet environment, even belonging to wet forest ecosystems (BEDARD, 1958). Finally some species are also hardly adaptative and therefore even invading, like *Bauhinia malabarica*. But the essential feature of woody *Bauhinia* species is a large fire resistance. This last feature is a positive element for the present survival of the concerned species in the Philippines. Nevertheless, we observed a weak capacity of regeneration, whilst fire pressure is still increasing. As far as lianas species are concerned, human pressure is a real danger for their plant population. Like everywhere in the world, the main pressure is woody cutting without any cut management nor environment policy (GANGULI 1995). *Pinus* plantations for wood production also contribute greatly to threatening. They induce higher acidity of the soil that inhibits most indigenous species to develop.

Several authors have stressed the urgent need of transfert of forest management to local people (BANERJEE & MISHRA, 1995), but this alternative paradigm has still to be realised in order to reduce forest decline in the Philippines (KUMMER, 1992).

CONCLUSION

Most of the studied sites are in danger and their plant species threatened of extinction because human pressure. During our field's study, we have noticed the difficulty to find natural untouched forest or savanna areas. Even if the genus *Bauhinia* is often very adaptative, a lot of other indigenous or endemic species are seriously threatened.

The Palawan island is a world biosphere reserve, but without any forest management. The dry ecosystems of this island are therefore became a degraded environment. Any attention is proofed to this kind of vegetation unit, because there are only of the dry forest type and not enough impressive like the humid rain forests (RICHARD & LOVEJOY, 1995). We think that it's greatly time to pay some interest to

dry tropical ecosystems in the world, not only regarding their biodiversity (URIARTE, 1994) but also because they really are buffer zones between human environment and "pure" forest stands.

REFERENCES

- BANERJEE A. & MISHRA H., 1995. Transfer of productive forests to local people : an alternative paradigm for forest management. In : *Emerging issues in forest management for sustainable development in South Asia, Proceedings*, pp. 85-90
- BEDARD, P.W., 1958. Reconnaissance, classification and mapping of Philippines forests. In : *Proc. Symposium on Humid Tropic's Vegetation, UNESCO*, pp. 9-53
- GANGULI B., 1995. Policy environment for forest management for sustainable development : an overview. In : *Emerging issues in forest management for sustainable development in South Asia, Proceedings*, pp. 9-13
- KUMMER D.M., 1992. Upland agriculture, the land frontier and forest decline in the Philippines. *Agroforestry Systems* 18, 1, 31-46
- LARSEN K. & LARSEN S.S., 1993. New taxa and nomenclatural combinations in Malesian *Bauhinia* (Leguminosae-Caesalpinioideae). *Nord. j. bot.* 13, 6, 657-665.
- PRANCE, G.T. & CAMPBELL, D.G., 1988. The present state of tropical floristics. *Symposium on Tropical Botany, Utrecht Taxon.*, 37, 3, 519-548
- PUTZ, F.E. & MOONEY, H.A., 1991. *The biology of vines*. Cambridge University Press, Cambridge (England), 526 p.
- RICHARD B.P. & LOVEJOY T.E., 1995. Ecology, conservation, and management of southeast asian rainforests. *Yale University Press, New Haven & London*, 304 p.
- URIARTE M.T., 1994. Biodiversity in Philippine forests : a situationer. *The Philippine lumberman, May-June 1994*, pp. 6-9
- WATSON, L. & DALLWITZ, M.J., 1983. *The genera of Leguminosae-Caesalpinioideae. Anatomy, Morphology, Classification and Keys*. The Australian National University Research School of Biological Science. Canberra (Australia), 95 p.

Annexe – Complete latine names

Antidesma ghaesembilla (Euphorbiaceae)
Blumea riparia (Blume) DC. var. *megacephala* Randeria (Asteraceae)
Bridelia stipularis (L.) Bl. (Euphorbiaceae)
Capillipedium parviflorum (R.Br.) Stapf in Prain (Poaceae)
Christia obcordata (Poir.) Bakh. f. ex van Meeuwen (Fabaceae)
Chromolaena odorata (L.) R.M. King & H. Rob. (Asteraceae)
Cissus sp. (Vitaceae)
Elephantopus mollis H.B.K. (Asteraceae)
Euphorbia hirta L. (Euphorbiaceae)
Evolvulus alsinoides L. (Convolvulaceae)
Fimbristylis dichotoma (L.) Vahl (Cyperaceae)
Guioa koelreuteria (Blanco) Merr. (Sapindaceae)
Heteropogon contortus (L.) Beauv. ex R. & S. (Poaceae)
Hyptis suaveolens (L.) Poir. (Lamiaceae)
Imperata cylindrica (L.) Beauv. (Poaceae)
Indigofera glandulifera Hay. (Fabaceae)
Merremia hirta Merr. (Convolvulaceae)
Mussaenda philippica L.C. Rich. (Rubiaceae)
Neonauclea sp. (Rubiaceae)
Ophiuros megaphyllus Stapf ex Haines (Poaceae)
Oplismenus compositus (L.) Beauv. var. *compositus* (Poaceae)
Paspalum orbiculare Forst. (Poaceae)
Pittosporum pentandrum Merr. (Pittosporaceae)
Premna odorata Blanco (Verbenaceae)
Psidium guajava L. (Myrtaceae)
Serialbizzia acle (Blanco) Kost. (Mimosaceae)
Smilax elmeri Merr. (Smilacaceae)
Themeda triandra Forsk. (Poaceae)
Triumfetta bartramia L. (Tiliaceae)
Vitex parviflora Juss. (Verbenaceae)