



**Diversity of Vascular Plants in the Floodplain Vegetation of Trang River Basin,  
Trang Province, Peninsular Thailand**

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**A Thesis Submitted in Partial Fulfillment of the Requirements  
for the Degree of Master of Science in Botany**

**Prince of Songkla University**

**2011**

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**Thesis Title**            Diversity of vascular plants in the floodplain vegetation of  
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ชื่อวิทยานิพนธ์	ความหลากหลายของพืชมีท่อลำเลียงในบริเวณที่ราบน้ำท่วมถึง ลุ่มแม่น้ำตรัง จังหวัดตรังในคาบสมุทรมไทย
ผู้เขียน	นายพลวัต ภัทรกุลพิสุทธิ
สาขาวิชา	พฤกษศาสตร์
ปีการศึกษา	2553

### บทคัดย่อ

ศึกษาพรรณพืชและสังคมพืชมีท่อลำเลียง ในบริเวณที่ราบน้ำท่วมถึงลุ่มแม่น้ำตรัง จังหวัดตรัง ระหว่างเดือน พฤศจิกายน พ.ศ. 2551 ถึงเดือน มกราคม พ.ศ. 2553 พบพรรณไม้จำนวน 171 ชนิด จาก 135 สกุล 62 วงศ์ ในจำนวนนี้เป็นพืช กลุ่ม โมนิโลไฟต์ (monilophytes) 7 ชนิด และเป็นไม้ดอก 164 ชนิด วงศ์ที่พบ กระจายทั่วไปและมีจำนวนชนิดมากที่สุด คือ Cyperaceae (23 ชนิด) รองลงมาคือ Fabaceae (13 ชนิด) และ Poaceae (12 ชนิด) จากการวิเคราะห์สังคมพืช ตาม ลักษณะความคล้ายคลึงกันขององค์ประกอบพรรณไม้ สามารถแบ่งสังคมพืชออกได้เป็น 9 ประเภท ได้แก่ 1) สังคม *Actinoscirpus* 2) สังคม *Barringtonia-Lagerstroemia-Nauclea* 3) สังคม *Eleocharis-Fimbristylis* 4) สังคม *Lagerstroemia-Streblus-Ziziphus* 5) สังคม *Mitragyna* 6) สังคม *Mitragyna-Lagerstroemia-Glochidion* 7) สังคม *Paspalum-Cynodon-Hymenachene* 8) สังคม *Streblus-Ziziphus-Adenanthera* และ 9) สังคม *Utricularia-Eriocaulon* ความแตกต่างขององค์ประกอบพรรณ พืชและ โครงสร้าง ในสังคมแต่ละประเภทอาจ เป็นผลมาจาก การอยู่ในลำดับขั้นของกระบวนการเปลี่ยนแปลงแทนที่ (succession) ที่ต่างกัน รวมถึงความแตกต่างของ ระยะเวลาและระดับน้ำในช่วงเวลาน้ำท่วม ได้เสนอภาพตัดขวางของ สังคมพืชทั้งที่เหลืออยู่ในปัจจุบันและ ที่คาดว่าเคยเป็นในอดีต ในบริเวณที่ราบน้ำท่วมถึงลุ่มแม่น้ำ ตรัง จังหวัดตรังไว้ด้วยแล้ว

**Thesis Title** Diversity of vascular plants in the floodplain vegetation of Trang River basin, Trang province, Peninsular Thailand

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**Major Program** Botany

**Academic Year** 2010

## ABSTRACT

Floristic and vegetation study on the floodplain areas of Trang River basin, Trang province were carried out from November 2008 to January 2010. One hundred and seventy one species of vascular plants belong to 135 genera and 62 families were identified. Among those, seven species are Monilophytes and 164 species are Angiosperms. The most common families are among Cyperaceae (23 species), Fabaceae (13 species), and Poaceae (12 species), respectively. The vegetation on the floodplain areas of Trang River basin were classified into nine types based on the floristic composition, i.e. 1) *Actinoscirpus* grassland, 2) *Barringtonia-Lagerstroemia-Nauclea* woodland, 3) *Eleocharis-Fimbristylis* grassland, 4) *Lagerstroemia-Streblus-Ziziphus* shrubland, 5) *Mitragyna* shrubland, 6) *Mitragyna-Lagerstroemia-Glochidion* shrubland, 7) *Paspalum-Cynodon-Hymenachene* grassland, 8) *Streblus-Ziziphus-Adenantha* shrubland, 9) *Utricularia-Eriocaulon* grassland. The spatial variation in structure and composition among the community types in the present study might due to different stages of secondary succession and water regime. The profiles of present as well as expected vegetation across Trang River floodplain had been proposed.

## ACKNOWLEDGEMENTS

I would like to express my whole gratitude to my thesis advisor, Associate Professor Dr. Kitichate Sridith for his kind advice and discussion throughout my study.

I would like to express sincere thanks to the examining committee: Prof. Dr. Thaweesakdi Boonkerd and Dr. Sahut Chantanaorrapint for their valuable suggestion and correcting the thesis.

Thanks also to Mr. Thammarat Putthai for the fieldwork assisting and most of the photos in this thesis.

The staff in the Herbarium at Department of Biology (PSU): Dr. Chukiat Laongpon, Mr. Jareunsak Sae Wai, Miss Naiyana Tetsana, Miss Kanok-on Boonpa, Miss Janejaree Inuthai, and Miss Milica Stankovic are thanked for their friendship and various kinds of help.

I am deeply indebted to the Graduate School, Prince of Songkla University, Hat Yai, Songkhla, the Research Assistantship from Faculty of Science (RA), Prince of Songkla University, the TRF/BIOTEC Special Program for Biodiversity Research and Training grant BRT T152100 for financial supports.

Finally, my deepest gratitude goes to my parents for their supports.

Ponlawat Pattarakulpisutti

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# CHAPTER 1

## INTRODUCTION

Floodplains are the flat lands, adjacent to the streams or rivers, and subjected to the periodic inundation (Finlayson and Moser, 1991). Generally, flooding is an important environmental factor that limits on growth and species distribution of plants (Jackson and Colmer, 2005). However, because of the flood pulse, the advancement and retraction of water on floodplain, that leads to the temporal shift in the boundary between aquatic and terrestrial habitats, thus the floodplain ecosystem is neither the aquatic ecosystem in the classical view nor the terrestrial one (Junk *et al.*, 1989; Bayley, 1995). This marked seasonal change in water level which imposes a great number of constraints for the biota inhabited the floodplain by causing abrupt changes in availability of nutrients, oxygen level, and sediment dynamic (Junk *et al.*, 1989; Parolin *et al.*, 2004b; Ferreira *et al.*, 2010). Thus plants species inhabiting these environments need to have special modifications which enable either tolerance of these changes, through physiology or morphology, and/or avoidance through life history traits (Capon, 2005). The floodplain is, on that account, the unique habitat which is interesting in terms of flora, morphological/physiological adaptations, growth strategies and the structure of vegetation. Moreover, due to the diversity of fluvial landforms e.g. oxbow lakes, point bars, and natural levees etc. and the highly dynamic of this habitat, that create a complex gradient of abiotic factors across floodplains in both spatial and temporal scale, the study of relationships between plant species/plant communities distributions and the environmental gradients as well as the vegetation dynamic are also interesting.

Not only the botanical views of importance, this vegetation is considered as an important habitat for lots of animals both terrestrial and aquatic. It also provides a nursery place for the larvae as well as feeding/breeding areas of the aquatic fauna in the flood season (Bayley, 1995). Owing to the fact that it is a transition zone between terrestrial and aquatic ecosystems, floodplains play a vital role by purifying water before flow into the rivers (Society of Wetland Scientists,

2009). Moreover, floodplain is among the ecosystem that produces highest primary production (Bayley, 1995).

So far, the studies on the vegetation of this valuable ecosystem have been undertaken for long time only mainly in Amazonia and Central America (Beard, 1946; 1955; Black *et al.*, 1950; Lindeman and Moolenaar, 1959; Sioli, 1964; Prance, 1979; Campbell *et al.*, 1986; Kubitzki and Ziberski, 1994; Nebel *et al.*, 2001a; 2001b; Lopez, 2001; Lopez and Kursar, 2003; Palorin 2003; Paralin *et al.* 2004a; 2004b). The understanding in biology of plants, their relationship with environmental factors, and their roles in ecosystem are quite well in those mentioned regions. Contrary to the Asian counterpart, though there are many the great extent of the fresh-water swamp habitats especially on the continent (Whitmore, 1975), it is a pity that there is no information on this ecosystem so far, even on the plant species composition of the floodplain areas.

The peninsular Thailand is a part of the continental south-east Asia. It lies in the northern part of the Malay Peninsula and has many short rivers throughout. These have created the unique phenomena of inundation in such places of at least once a year, mostly after the rainy season. The plant communities which developed on these habitats have unique characteristic as well, owing to the fact that they must stand the flood period. Moreover, when the diversity of plant in the study areas is taken into account, it is to be noticed that the Peninsular Thailand falls into two main biogeographic regions i.e. the Continental south-east Asian and the Malesian one which are roughly separated from each other by the Kangar-Pattani line which run from a town of Kangar in Malaysia to a town of Pattani in Thailand (Good, 1964; Takhtajan, 1986; Woodruff, 2003). Whitmore (1975) had estimated 7,900 species and 1,500 genera of seed plants in this area.

In spite of the importance of the vegetation and flora in these mentioned areas, it is a pity that there is no any information on the plant species composition of the floodplain areas in peninsular Thailand so far. Besides, the floodplain areas in the peninsular Thailand are among the most endangered areas as they are going to be terminated by many human activities e.g. irrigation projects, agriculture, tourism etc. So, the study in order to get an account of the floristic composition of such plant communities is, therefore, urgently needed.

Though most vegetation of the floodplain areas in peninsular Thailand have been depleted, some relicts of them are even left as separated remnant patches. These remnant patches are rather important as some of them contain many native original plant species of the floodplain vegetation, some are even the original ones. The present study was aiming to document the remnant of this valuable wetland vegetation on the Trang river-basin in the peninsular Thailand which left as separated patches before it would be completely disappear. Moreover, the present study might be the first record on the vegetation data of the floodplain forest in Thailand.

### **TRANG RIVER BASIN**

Trang River is a short river (123 km. length) in the west coast of the peninsular Thailand. This river is interesting, because it is the only river in the western coast of peninsular Thailand that reaches a low-lying plain, a Trang River basin, created a big flooding areas in that basin in the flood season. And it is to be noticed here that on the western coast of Thailand, the floodplain is uncommon due to the generally steep gradient which major rivers flow. The big floodplain could be found along Trang River only. The present study aimed to account the floristic composition of the vegetation on the floodplain basin of Trang River system together with the discussion on their morphological adaptations if any as well as the vegetation structure and the phytogeographic data of the plant species occurring in such vegetation. This is the first step toward the understanding of the ecological process underlying this vegetation and ecosystem as well as the plant species resource management and conservation in the areas of peninsular Thailand and Malaysia.

## **OBJECTIVES**

1. To document the species composition of vascular plants in the floodplain vegetation of Trang River basin, Trang province, Peninsular Thailand.
2. To obtain the data of adaptation traits of those vascular plants with particular attention on morphology and growth strategy/life form.
3. To gain information about geographical distribution of vascular plants in the floodplain vegetation of Trang River basin.
4. To obtain information on the community types and their structure in the floodplain vegetation of Trang River basin.



## LITERATURE REVIEW

### **Botanical studies on floodplain vegetations in Amazonia and Central America**

Floodplain vegetation has been studied for long time mainly in Amazonia and Central America.

In Amazonia, floodplain vegetation could be roughly divided into two types based on flooded water: (1) *várzer*-forest flooded by regular annual cycles of “white water” or nutrient and suspension-rich water: (2) *igapó*-forest flooded by regular annual cycles of “black water” or nutrient and suspension-poor water. In addition, not only the difference in nutrient and suspension content, but these kinds of water are also marked difference in acidity. The blackwater rivers have a pH of 4.5–5.2 while the whitewater rivers have pH 6.9–7.4 (Schmidt, 1972; Anonymous, 1972 cited after Prance, 1979).

Beard (1946 cited after Richards, 1996; 1955) studied the vegetation of Trinidad and other parts of tropical America and made a distinction between “swamp forest” which is permanently flooded and “marsh swamp forest” which is flooded seasonally.

A similar distinction was made by Lindeman and Moolenaar (1959 cited after Richards, 1996) in their account of the coastal swamp of Suriname. The “marsh forest” (the seasonally flooded forest) in Suriname are two-storeyed. The ground cover is usually bared muddy depression and trees usually grow on terrains. It is interesting to note that the marsh forest in Suriname usually showed the marked single species abundance.

Black *et al.* (1950) estimated species diversity and population density of tree more than 10 cm dbh in Brazilian Amazonia. They used three 1-hectare plots, one on terra firme of Rio solimões River, Tefé region and two on igapó and terra firme of Guamá River, Belem region. The result showed that terra firme are greater in both species diversity and number of tree individual than igapó.

Sioli (1964 cited after Richards, 1996) described the fluvial landforms and their association with particular kind of vegetation at floodplain between Xingú mouth and the Rio Negro, Brazilian Amazonia. The whole floodplain may be up to 100 km wide and there are many islands which grow by alluvial deposition. Between

main channel and terra firme, there are many strips of várzer and lavées, the relative high feature forming by deposition, and the low-lying plains. The lavées are not stable and prone to crumble in high floods together with trees growing on them. In low-lying plains, much of it consisting with lakes and back swamp where the seasonally grasslands and floating aquatic vegetations were forming.

Holdridge *et al.* (1971 cited after Richards, 1996) described the vegetation dominated by *Prioria copaifera* Griseb., the large leguminous tree. The *Prioria* trees form the nearly pure stand and dense canopy. This vegetation was found on terraces near the river bank so it was occasional flooded and could be categorized as “the marsh forest” of Bred’s definition.

Due to inconsistent usage of the terms which applied to Amazonian inundated forests among limnologists and ecologists, Prance (1979) proposed to define accurately the terminology of the Amazonian forest types subjected to inundation. He defined three types of seasonally flooded forest i.e. (1) seasonal várzer, (2) seasonal igapó, and (3) floodplain forest. The seasonal várzer is the most widespread and supports the highest diversity of all types of inundated forest in Amazonia. Buttress and pneumatophores are common. In addition, species composition and structure of the forest vary, due to the differences in duration of flooded period among sites. The seasonal igapó is flooded by low nutrient water and most of the areas are sandy soils. As a result, it supports less diversity of plants than the seasonal várzer and the vegetation structure, also, is less complex. In some areas during the dry period, the vegetation experience the desert-like condition and xeromorphic character such sclerophyllous leaves are common. Trees and shrubs of many species are endermic to this habitat. However, physiognomy of “várzer-like” could be found in richer soil such as delta region. The floodplain forest refers to the forest that is flash-flooded by irregular rainfall. This forest is flooded by heavy rainfall at any time of the year rather than by the regular seasonal flooding of large rivers. Species composition and structure are similar to the seasonal várzer. In the less flooded areas, various species characteristic of *terra firme*, the non-flooded forest also found.

Campbell *et al.* (1986) studied on diversity and structure of várzer and nearby terra firme forest at Rio Xingu, state of Pará, Brazil. The dominant species (the

most important species) of trees with dbh more than 10 cm in terra firme were *Cenostigma macrophyllum* Tul. (Fabaceae) and *Orbignya* sp. (Arecaceae). In várzer, the dominant species were *Mollia lepidota* Spruce ex Benth. (Malvaceae) and *Leonia glycyarpa* Ruiz & Pav. (Violaceae). The dominant families of terra firme and várzer similar i.e. Fabaceae and Arecaceae. The trees in the várzer did not exceed 25 m high and the emergent of the terra firme were considerably taller. They also compared the species diversity between these types of forest and found that the várzer was less rich than the terra firme.

Nebel *et al.* (2001a; 2001b) studied on the structure and composition of three types of floodplain, high resting, low resting, and tahuampa, which are characterized by an annual inundation of one, two and four months per year respectively at Ucayali River, Peru. The results indicated that tahuampa was the most rich species diversity. The floristic similarity among the forest types was low. They also concluded like Campbell *et al.* (1986) that the floodplain forest contains fewer tree species than adjacent non-flooded terra firme forest. In addition, base on Family importance value (FIV), Peruvian floodplain forests were rather similar in familial composition with Ecuadorian than Brazilian floodplain forests.

Parolin *et al.* (2003) studied on the floristic composition and structure of floodplain forest at the Anavilhanas archipelago, the world's greatest freshwater archipelago at Brazilian Amazonia. The most common families were Fabaceae, followed by Apocynaceae and Violaceae. The vegetation in the study area contains tree species which were characteristic of the seasonal igapó as described by Prance (1979). However, many species were common in both terra firme and várzer. This may be a consequence of the influence of the Rio Brenco, the whitewater river that enters the Rio Negro which close to the Anavilhanas archipelago. And some terra firme species may established in shortly flood period. This study also found that the species number and the diversity were lower than those in terra firme because of the flood stress in the floodplain.

Floristic composition and structure analysis of seasonal igapó at Rio Tarumá was performed by Parolin *et al.* (2004a). The results showed that more than 30% of total flora restricted to the seasonal igapó forest. They also found that the

variation in the species diversity, density, and family importance value among the plots were different in the flood duration.

Apart from the inventories of the floristic composition and structure, many studies on the adaptation and biology of plant species have been carried out in Amazonia and Central America floodplains as well. For example, Kubitzki and Ziberski (1994) were investigated the phenology i.e. fruiting period, timing of diaspores release, dormancy and/or requirement for germination of floodplain plants in their relation to the timing of flooding and the role of water and fishes in the dissemination of the diaspores. Maximum fruiting of the trees and the flood rising time were coincide. The specific timing of diaspores release appeared to relate the highest flooding. The synchronization of high water, fruit maturation and fish migration had been interpreted to facilitate the plant dispersal by water and fishes. The diaspores of most species were floating due to the modified structures such as spongy pericarp or air pocket cloud drift through water during the flood period. While the diaspores in some species were sink and usually has very hard pericarp were regarded as fish dispersed species.

The importance of seed flotation in maintaining population of floodplain species was confirmed by Lopez (2001). In that work, the comparison of floating ability, post-flooded germination, and rate of seedling expansion between floodplain and terra firme species were achieved. The buoyancy, post-flooded germination, and seedling expansion rate of floodplain species were greater than those of terra firme species. These results revealed that the dispersal by water is an important adaptation in the habitats where flooding is common. In addition, the lack of hydrochory among terra firme species may be a key selective filter contributing to the poor species diversity which could be found found in floodplain vegetation.

From many inventories, the common pattern that the floodplains harbor fewer plant species that the terra firme could be seen. The hypothesis that might explain low richness in floodplain vegetation maybe the inability of terra firme species in colonizing the floodplains is due to the flood stress. Lopez and Kursar (2003) tested this hypothesis by comparing the flood tolerance ability of plant species from terra firme and the seasonally flooded forest at Barro Colorado Island, Panama. The result showed no evidence that the seasonal flooded forest species and the terra

firme species differed in their response to flooding phenomena. This result also revealed that although flood tolerance is critical for the survival in flooded habitats, the response to post-flooding phenomena such as drought might be equally important in this seasonal changed habitat as well.

Parolin *et al.* (2004b) reviewed many aspect of adaptations of tree species in central Amazonian floodplain. The diaspores dispersal-mechanism of tree species in the floodplain was regarded as hydrochory and ichthyochory due to a close correlation in the timing of flooding which accompanied by fish immigration, as well as fruit maturation. The tree species usually released diaspores at the high flood period. After the diaspores fall into the water, they either floated or were submerged for several weeks to months without losing their viability and they established soon after the water recedes. In adult trees, many species formed the increment rings and periodic shoot elongation because of the reduction of growth rate during flooding. Morphological adaptations of root system in the floodplain species were also described. Different types of above ground roots are closely related to flooding duration and habitat dynamic. Buttress usually found on sites subjected to lower sediment rate, whereas in high sediment rate still roots are more common. Pneumatophores are absent in várzer trees, probably due to the constant changing in water level. Aerenchyma is important to the root longitudinal oxygen transportation and appear to be essential for improving the root's energy status for water and nutrient uptake. However, in older roots, aerenchyma is less important for longitudinal oxygen transport because the lacunae were destroyed by secondary root thickening. In this condition, an improvement of the root's energy status is achieved by reducing the number of oxygen-consuming cells.

### **Botanical studies on floodplain vegetations in Tropical Africa**

In Congo Basin, the floodplain is very large and consists of both periodically and permanently waterlogged soils. In some large tributaries, the water is turbid and comparable as “whitewaters” in Amazon, but the water in most place is “black water” (Evrard, 1968 cited after Richards, 1996). The variation in plant communities in this region is probably depending on the characteristic of these

waters. However, more important agents are flooding regime, soil types which vary from silts to peaty soils, and natural disturbance i.e. erosion (Richards, 1996).

Louis (1947 cited after Richards, 1996) studied the succession of vegetation on fresh water islands at the Congo River near Yangambi, Congo. The four main seral stages were recognized using space-for-time substitution from the frequently disturbed to more stable areas i.e. (1) a pioneer association mainly of grasses and sedges (2) a sward of rhizomatous grasses (3) shrub community (4) seasonal flooded forest.

Evrard (1968 cited after Richards, 1996) in the study of vegetation on Central basin, Congo River described the seasonally flooded *Oubanguia africana-Guibourtia demeusii* association and permanently *Entandrophragma palustre-Coelocaryon botryoides* alliance as the “edaphic climax” in inundated soils. The former was found on floodplains of Congo and others large rivers where flooded lasts from 3–4 months. This association is distinctly stratified with an A storey at 35–40 m and B strata at 20–25 m. Buttresses, still roots and pneumatophore are rare. For the *Entandrophragma palustre-Coelocaryon botryoides* alliance, this was found on permanently waterlogged-organic substrate. The trees in this alliance are less tall than than *Oubanguia africana-Guibourtia demeusii* association. The roots systems are shallow, pneumatophore are common.

Richards (1939) reported the floristic composition and structure of vegetation in waterlogged area with particular attention on fresh water swamp forest in his expedition of the rain forest of southwestern Nigeria. The number of species was relatively low and most of the components restricted to the swampy areas. Moreover, the structure was resembled the adjacent non-flooded forest but the canopy is more open. The forest has two strata. Tall trees are abundant but clumpy distributed. These are mixed with dense thicket and of bushes and woody climbers. Still roots are common but the buttresses are apparently rare.

### **Floristic inventories on floodplain vegetation in Tropical Asia**

In mainland Southeast Asia much of the fresh water swamp vegetation has been destroyed and replaced by agricultural areas such as rice paddies and rubber plantations for long time, and only small patches of the natural vegetation remain

(Whitmore, 1975; Richards, 1996). The extensive areas of the swamp vegetation could be still found in Borneo, Sumatra and New Guinea. However, so far, the literatures of floodplain vegetation in this region are rather scarce. Only brief descriptions of fresh water swamp vegetation were reported in New Guinea and Solomon Islands.

Whitmore (1969) surveyed on the vegetation of Solomon Islands and described the freshwater swamp forest which dominated by *Terminalia brassii* Exell. This species forms nearly pure stand with the large mass of interlocking aerial roots.

Paijmans (1976) in his study of the vegetation of Papua New Guinea had described 14 types of the lowland fresh water swamps covering both permanent and seasonal inundated areas. The floristic composition and structure of the vegetation varies from aquatic vegetation, grassland swamp, swamp savannah, swamp woodland, and swamp forest depending on the depth, frequency, and duration of flood water. In deep and prolong-flooded condition, the aquatic vegetation is dominant whereas in shallower and brief flooding trees and shrubs are more common and forming the woodlands or swamp forests.

### **Previous accounts of botanical studies of floodplain vegetation in Thailand**

The list of flowering plants in tidal region along Bang Nara River and its adjacent inland leading to Toh Daeng peat swamp forest was reported by Niyomdham (1986). Eighty eight families and two hundred and ninety seven species of plants were recorded, of which 48 species were new record of Thailand. Some characteristics of tree species inhabiting swamp areas such as buttresses, pneumatophores, and still roots also noted. However, the given details of the habitats in this study were not clear. The study site might cover gallery forest, floodplain, and peat swamp forest.

Santisuk (2006) in his review of the forest formations in Thailand had described the general features of floodplain vegetation. The floodplain vegetations in Thailand are found on large rivers such as Tapi, Chao Phraya, Mun, and Chi River. The vegetation structure and floristic composition of the vegetation varies, depending on fluvial landforms, amplitude of flood water, and edaphic condition along the river. In prolonged-flooded areas the vegetation is mainly composed of herbs and some

scattering of trees and shrubs, whereas in the higher parts of the plains are occupied by more trees and shrubs. List of some characteristics species in floodplain vegetation of Thailand are also provided.



## CHAPTER 2

### MATERIALS AND METHODS

#### STUDY AREA

##### 1. Location

The field surveys were conducted on the floodplain of Trang River and its tributaries at Muang Trang district ( $7^{\circ}30'13''$ – $7^{\circ}39'20''$ N and  $99^{\circ}31'40''$ – $99^{\circ}36'12''$ E), Trang province. This short river (about 123 km. length) is located on the west coast of the peninsular Thailand. It has its origin in the Banthat range, Phatthalung province, which divides the peninsula into two parts, i.e. the east coast and the west coast. It flows through 5 districts of Trang province and empties into the Andaman Sea at Kantang district.

##### 2. Climate

The climate of the area is tropical monsoon climate (Am) according to Köppen's classification (Kottek *et al.*, 2006) with mean temperature of 27.4 °C and the average annual rainfall 2,187.8 mm (during 1961–1990). The heaviest rainfall is in September with average monthly rainfall of about 352 mm (Thai Meteorological Department, 2010). The relative humidity ranges from 62% in the dry season to 96% in wet season (Thai Marine Meteorological Center, 2010). The mean annual runoff 2,203.42 million m<sup>3</sup> (during 2005–2009) which reach the highest during October to December and lowest in January to April (Hydrology and Water Management Southern Region, 2011).

##### 3. Study area and study plots (relevé)

Since the Trang River basin is rather small (2,212 km<sup>2</sup>) (Hydrology and Water Management Southern Region, 2011) and most of the floodplain vegetation has been terminated by various human activities, only separated patches of remnant vegetation have been left near the river channel, which could be roughly estimated as six km<sup>2</sup>. The most remote study plot is only around two kilometers next to the river channel's bank (Figure 1). The differences on depth, and duration of flood

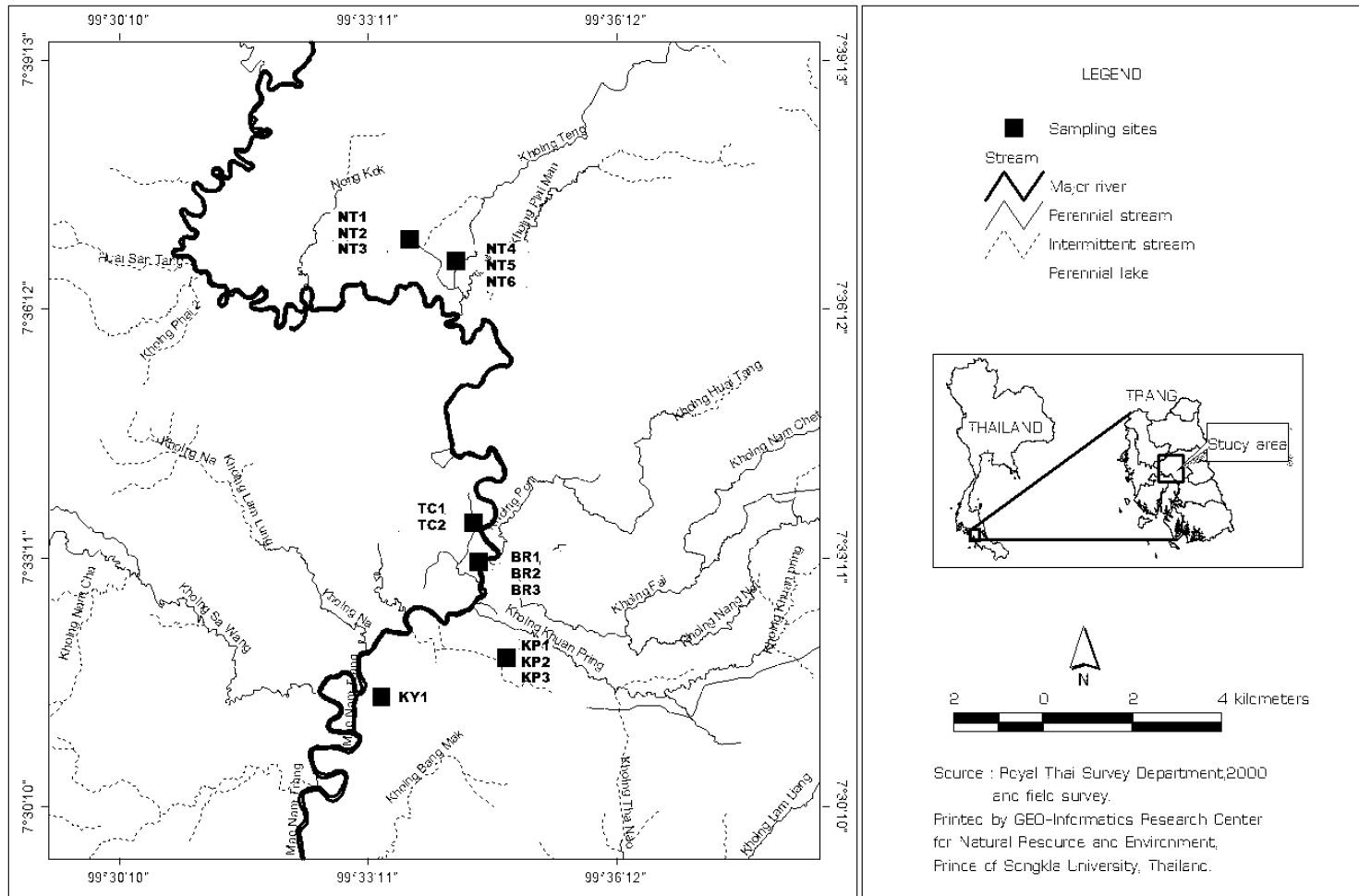
water among study sites in the present study seem to be a result of the local topographic relief due to various human activities i.e. land preparations for agricultural purposes, etc.

Fifteen study plots (relevé) were selected within the remnants of the floodplain vegetation. The characteristics of each study plot were shown in Table 1. Due to the lacking of any proper hydrological station in the Trang River basin, the flood durations in the present study were estimated by field observations.

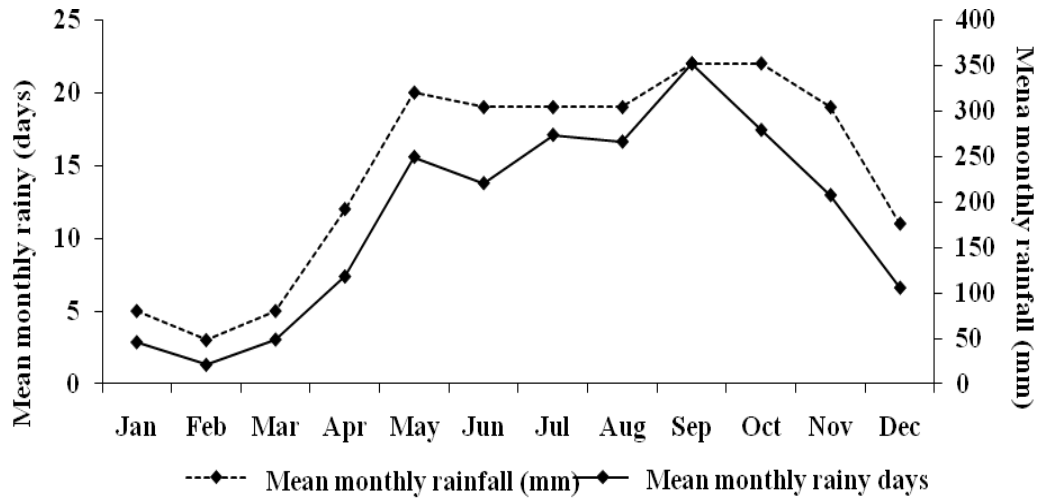
**Table 1.** Study plots descriptions and their habitat characteristics along Trang River Floodplain.

Study plot reference number <sup>1</sup>	Map reference	Elevation (m)	Site description	Flood duration time	Water depth (cm)
BR1	N 07° 33' 16" E 099° 34' 45"	10	Old rice field	Sep.-Nov.	ca 30
BR2	N 07° 33' 16" E 099° 34' 45"	10	Old rice field	Apr.-Nov.	ca 30
BR3	N 07° 33' 16" E 099° 34' 45"	10	Termite hills	rarely	
TC1	N 07° 33' 35" E 099° 34' 45"	11	Old rice field	Aug.-Nov.	ca 30
TC2	N 07° 33' 35" E 099° 34' 45"	11	Termite hills	rarely	
KP1	N 07° 32' 14" E 099° 34' 51"	15	Disturbed	Sep.-Nov	ca 30
KP2	N 07° 32' 11" E 099° 37' 52"	15	Chopped	Sep.-Nov.	ca 30
KP3	N 07° 32' 11" E 099° 37' 52"	15	Natural vegetation	Sep.-Nov.	up to 100
KY1	N 07° 31' 35" E 099° 33' 14"	9	Old rice field	Through year	up to 100
NT1	N 07° 34' 57" E 099° 35' 10"	14	Old rice field	Apr.-Nov.	ca 30
NT2	N 07° 34' 57" E 099° 35' 10"	14	Old rice field	Through year	up to 100
NT3	N 07° 34' 57" E 099° 35' 10"	14	Disturbed	rarely	
NT4	N 07° 35' 06" E 099° 35' 20"	12	Termite hills	rarely	
NT5	N 07° 35' 06" E 099° 35' 20"	12	Old rice field	Sep.-Nov.	ca 30
NT6	N 07° 35' 06" E 099° 35' 20"	12	Old rice field	Apr.-Nov.	ca 30

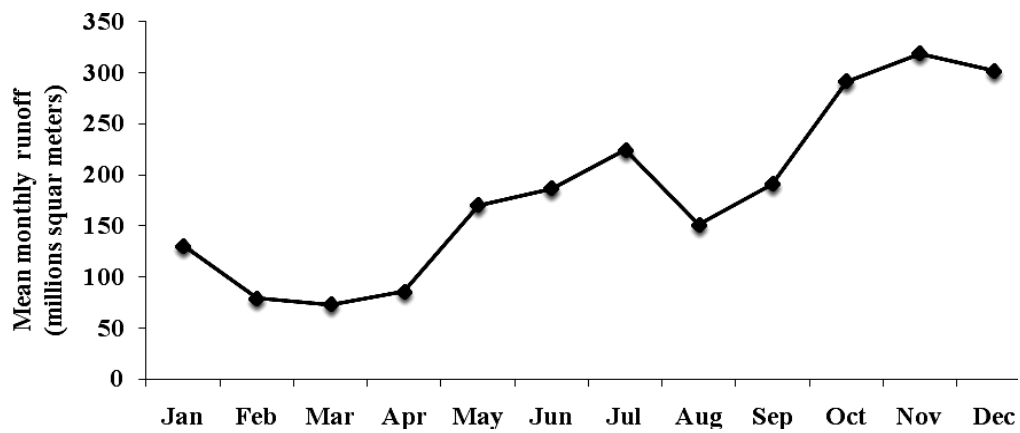
<sup>1</sup>Study plot reference number: BR1, BR2, BR3= Ban Bang Rak; TC1, TC2= Ban Tha Chin; KP1, KP2, KP3= Ban Khuan Pring; KY1= Ban Kok Yang; NT1, NT2, NT3, NT4, NT5, NT6= Ban Na Tham Tai.



**Figure 1.** Map of Trang River basin showing locations of the study plots.



**Figure 2.** Monthly rainfall of Trang province during the years 1961–1990 (Data from the Thai Meteorological Department, 2010).



**Figure 3.** Amount of runoff of Trang River at Ban Pak Mun station (X. 234), Muang Trang district, Trang province during the years 2005–2009 (Data from the Thai Meteorological Department, 2010).

## **DATA COLLECTION**

### **1. Inventory and study plots (relevé) selection**

The study plots (relevé) were subjective selected in accordance with the Braun-Branquet approach (Kent & Coker, 1994) within the remnants of the “natural” floodplain vegetation and inundation range from rarely to permanently flooded (Table 1.). In this case the term “natural vegetation” means a system of largely spontaneous growing plants (van der Maarel, 2005), so they can be both “primary” and secondary vegetations. A study plot was deliberately selected if in the opinion of a researcher that it is a representative area of a particular community type which is distinct from the surrounding vegetation in term of floristic composition and structure. It was assumed that each study plot had to cover a minimum survey space in a habitat which shows homogeneity of physiognomy as well as the dominant plant species.

### **2. Plant collection**

Data collection in study plots was carried out once a month from November 2008 to January 2010 in order to cover all seasons, fluctuations of rain-falls and inundation. The plants species which occur outside the plots were also collected if they were found in the areas of floodplain in order to complete the account of floodplain species. However, those species were not included in vegetation classification Plant collections were made with field notes of some diagnostic characters such as smell, color etc. Ecological data, growth strategies/life forms and photographs were also taken in the field. Specimens were processed as directed in “The herbarium hand book” (Forman & Bridson, 1992).

### **3. Vegetation data collection**

All vascular plant species within the study plots were checked in order to make a complete species list. Trees and shrubs species were recorded together with the data on their positions, crown height, crown areas and diameter at breast height (dbh) in order to draw profile diagrams of the vegetations. Some selected environmental data such as flood duration time, magnitude and flood frequency in the

study plots were noted. Photographs were taken showing the general structure of the study plots.

The abundance of each plant species was measured by cover-abundance estimation using the Domin-Krajina scale (Kent & Coker, 1994). The numerical scales were recorded as follows:

- \*= a single individual. No measurable cover
- 1= 1–2 individuals with normal vigour. No Measurable cover.
- 2= Several individuals but less than 1% cover
- 3= 1–4% cover
- 4= 4–10% cover
- 5= 11–25% cover
- 6= 26–33% cover
- 7= 34–50% cover
- 8= 51–75% cover
- 9= 76–90% cover
- 10= 91–100% cover.

## **LABORATORY STUDY**

The collected specimens were identified with the available taxonomic literatures. Descriptions of plant species were made in order to gain morphological data of plant species found in the floodplain vegetation. Scientific names, author names, and abbreviation of publications in this thesis followed the International Plant Names Index (IPNI) (The Plant Names Project, 1999). Plant family classification followed Angiosperm Phylogeny Group (APG III, 2009).

The voucher specimens have been deposited at the Prince of Songkla University Herbarium (PSU) and Forest Herbarium (BKF), Department of National Parks, Wildlife and Plant Conservation, Ministry of Natural Resources and Environment, Bangkok, Thailand.

## VEGETATION ANALYSIS

### 1. Vegetation Classification

Cluster analysis was performed with PC-ORD software version 5.19 using Sørensen distance measure and group average method in order to classify the similar study plots into group base on their floristic composition. Each of these groups would then be characterized as a given community type. Each community type was (roughly) named according to the abundant species, physiognomy, and its habitat. The community types were described as well as photographs and the profile diagrams of some selected areas.

### 2. Relative abundance of growth strategies/life forms of community types

In order to explain spatial variation in the structure among community types based on above vegetation classification, all vascular plant species found on the study plots were assigned to various growth strategies/life forms categories. This classification is based on the assumption that differences in plant morphology and strategy would then reflect the different adaptation to various environmental conditions. It is frequently found that stands of vegetation with completely different floristic composition may have similar essential structure and life form as the result of an interaction of the similar complex of environmental factors. Thus, if the dominant growth strategies/life forms of given community type were investigated and considered with the environmental factors of study plots such as history of land use, flood duration and water depth etc., they may lead to understanding more of the spatial variations among those community types.

The abundance of each species of each community type was measured using its percentage cover. The relative abundance of each life form in each community type was then calculated by summing the percentage cover of the species in the same growth strategy/life form. Finally a relative abundance of growth strategies/life-forms in each community type was expressed as percentage.

The plant species were divided into broad categories of annual and perennial. The former contain all vascular plant species which complete their life-cycle within one year and survive the unfavorable period as seeds. Some species which usually regarded as perennial in other habitats may be included in annual



category if they show the distinct fluctuation in above ground-relative abundance through seasons in the floodplain. The perennial, in this study, means all vascular plant species which live for more than one year. Some plant species may disappear during an unfavorable period but their underground stems still remain i.e. rhizomes, corms. The perennial plants were subdivided into terrestrial and aquatic ones.

The aquatic plants mean plants that cannot live outside water for any significant period of time because most desiccate rapidly expose to the air (Tiner, 1991).

The terrestrial plants were separated into trees (t), shrubs (s), scandent (c), undershrubs (u), woody climbers (w), vines (v), epiphytes (e), geophytes (g), herbs(h). The aquatic plants were also divided, according to Finlayson *et al.* (1989) into emergent (em), floating-leaved anchored (fl), submerged anchored (sa), free floating submerged (fs), free floating (ff).

The annual plants were also subdivided into terrestrial and aquatic ones. The terrestrial plant means plant species which survive the flood period as seeds/or their relative abundance decrease during such period. All plant species in this category are herb. Whereas the aquatic plant means species which disappear in the dry period/or survive the dry period as seeds.

## CHAPTER 3

### RESULTS

#### PART I: FLORISTIC STUDY

##### Taxonomic diversity

There are 171 species of vascular plants belonging to 135 genera, 62 families were identified and listed in Appendix 1. Among those, seven species are Monilophytes and 164 species are Angiosperm (Table 3). The plant families with the largest number of species in each major group are shown in Table 2. The most common families of Eudicots are among Fabaceae (13 species, 7.6%), Phyllanthaceae and Rubiaceae (10 specie, 5.85%), respectively. Cyperaceae (23 species, 13.45%) and Poaceae (12 species, 7.02%) are among the most-diverse group of Monocots. In this study only two species of Magnoliids were found. In the case of Molinophytes, Pteridaceae (3 species, 1.7%) is the largest family. The observed number of species in this study might be underestimated, due to the undersampling of locally rare species. From estimation, there were at least 190 species of vascular plants in the floodplain vegetation.

**Table 2.** Predominant families of each major group found in Trang River floodplain vegetation.

Plant groups	Number of species	% of total flora
<b>Monilophytes</b>		
Pteridaceae	3	1.7
Polypodiaceae	2	1.2
Other monilophytes	2	1.2
<b>Eudicots</b>		
Fabaceae	13	7.6
Phyllanthaceae	10	5.85
Rubiaceae	10	5.85
Apocynaceae	8	4.68
Other eudicots	61	35.67
<b>Magnoliids</b>		
Annonaceae	1	0.585
Lauraceae	1	0.585
<b>Monocots</b>		
Cyperaceae	23	13.45
Poaceae	12	7.02
Other monocots	25	14.61
Total	171	100

**Table 3.** Number of families, genera and species in major groups of vascular plants found in the study site.

Plant groups	Families	Genera	Species	% of total flora
MONILOPHYTES	4	7	7	4.1
ANGIOSPERM				
-Eudicots	39	85	102	59.65
-Magnoliids	2	2	2	1.17
-Monocots	17	41	60	35.08
Total	62	135	171	100

### Geographical distribution groups

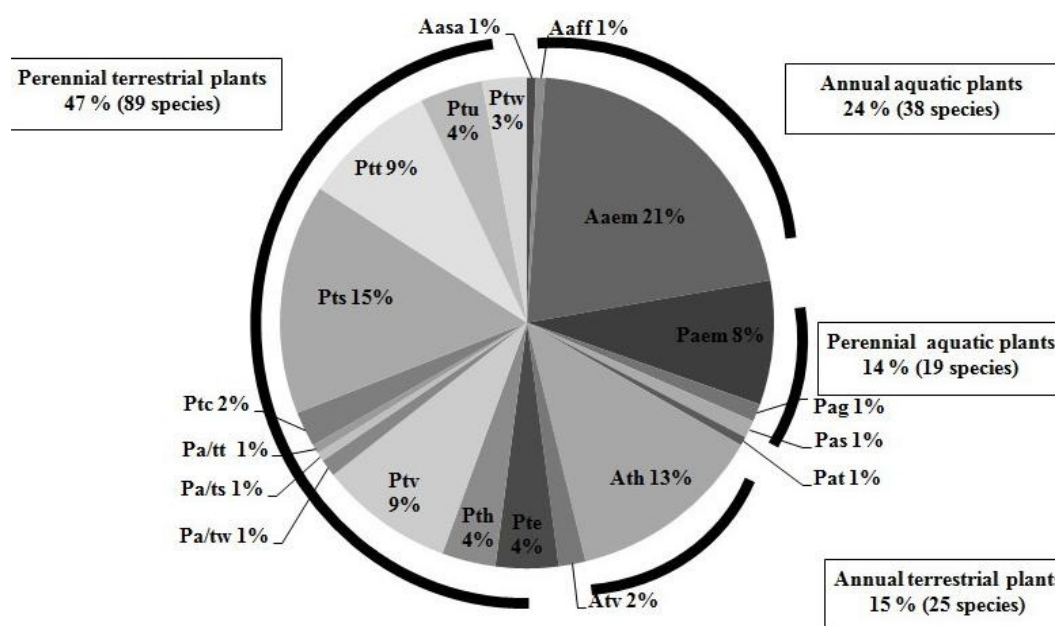
One hundred and fifty one from the 171 species recorded in the present study were divided into 13 types (Table 4). Twenty species were excluded from this analysis as they might be non-indigenous and some are unidentified. Those excluded species were noted in Appendix 1. From the table 4, the most common types is type 7 or the Indomalesian subkingdom elements (*sensu* Takhtajan, 1988) (59 species or 39.07%), followed by the widely distributed group or types 1–6 (38 species or 25.17 species), Indian and Indochinese element group or types 8–9 (22 species or 14.57%), Indochinese and Malesian element group or types 11–12 (19 species or 12.58%), Malesian element or type 13 (9 species or 5.96%) and Indochinese element or type 10 (4 species or 2.65%).

**Table 4.** Distribution of 146 vascular plant species found in the study sites.

Distribution types	Number of species		
	Herbaceous	Woody plants	Total
1. Cosmopolitan	1	-	1
2. Pantropics and subtropics	6	1	7
3. Pantropics	12	2	14
4. Paleotropics and subtropics	4	1	5
5. Paleotropics	7	1	8
6. Africa, India, Himalayas, Indochina, Malay Peninsula, Sumatra, Java	3	-	3
7. India, Himalayas, Indochina, Japan, Malesia, Northern Australia	38	21	59
8. India, Himalayas, Indochina, Malay Peninsula, Sumatra, Java, Borneo	7	-	7
9. India, Himalayas, Indochina, Malay Peninsula, Sumatra, Java	7	8	15
10. Himalayas, Indochina, Malay Peninsular	-	4	4
11. Indochina, Malay Peninsula, Sumatra, Borneo, Philippines	-	4	4
12. Indochina, Malesia	5	10	15
13. Malay Peninsula, Java, Borneo	4	5	9

### Growth strategies/life forms and morphological adaptations of plants in Trang River floodplain vegetation.

Based on growth strategies/life forms, the vascular plant species found on the Trang River floodplain vegetation could be categorized to four major groups i.e. (1) Annual aquatic plants, (2) Annual terrestrial plants, (3) Perennial aquatic plants, and (4) Perennial terrestrial plants (Figure 4). Each major group was also subdivided into subgroups as shown in (Figure 4). The most abundant group is a perennial terrestrial plants group (89 species, 47%), followed by an annual aquatic plants group (38 species, 24%), an annual terrestrial plants group (25 species, 15 %) and a perennial aquatic plants group (19 species, 14%).



**Figure 4.** Pie chart showing the percentage of growth strategies/life forms of vascular plants in Trang River floodplain vegetation.

Aasa= Annual aquatic submerged, Aaff= Annual aquatic free floating, Aaem= Annual aquatic emergent, Ath= Annual terrestrial herbs, Atv= Annual terrestrial vines, Pa/tw= Perennial aquatic/terrestrial woody climbers, Paem= Perennial aquatic emergent, Pag= Perennial aquatic geophytes, Pas= Perennial aquatic shrubs, Pa/ts= Perennial aquatic/terrestrial shrubs, Pa/tt= Perennial aquatic/terrestrial trees, Pat= Perennial aquatic trees, Ptc= Perennial terrestrial scandent, Pte= Perennial terrestrial epiphytes, Pth= Perennial terrestrial herbs, Pts= Perennial terrestrial shrubs, Ptt= Perennial terrestrial trees, Ptu= Perennial terrestrial undershrubs, Ptv= Perennial terrestrial vines, Ptw= Perennial terrestrial woody climbers

**Species descriptions**

In the present study, 171 species of vascular plants belong to 135 genera, 62 families were identified. The full descriptions together with localities, ecological data as well as distribution range of 126 species were provided. In addition, forty plant species found in the study sites could not be described in the full detail due to the fact that some collections were damaged during the study then lacking key characters such as flowers and fruits. However, they were included in Appendix 1.

Full descriptions are as follows:

**MONILOPHYTES****LYGODIACEAE**

1. *Lygodium microphyllum* R. Br., Prodr. Fl. Nov. Holland. 162. 1810; Takawa & K. Iwats. in Fl. Thailand. 3(1): 60. 1979.— *L. scandens* (L.) Sw., Schrad. Journ. 1800(2). 106. 1801; Holttum, Rev. Fl. Malaya 2: 58, fig. 15. 1954.

Climbing fern; rhizome creeping, 2–3 mm in diam. *Fronde* indeterminate growth; bipinnate, twining; stipe ca 10 cm long, glabrous; primary rachis up to several meters long, narrowly winged, glabrous; secondary rachis up to 12 cm long, narrowly winged, glabrous; petiolules 2–5 mm long, glabrous; leaflets 5–10, linear-elliptic to oblong-deltoid, 2–15 by 0.8–2 cm, chartaceous, glabrescent, base auriculate, margin narrowly lobed; lobed linear elliptic, 2–4 by 1 mm, apex obtuse to truncate, margin with a row of sori, entire. *Sori* along lobes of leaves margin; indusial serrate at margin, ca 0.5 by 0.5 mm, margin serrate glabrous. *Plate 2.A.*

**Thailand.**— Throughout Thailand.

**Distribution.**— Old World Tropics and north to the Ryukyus Islands and south to New South Wales.

**Ecology.**— On thickets or open areas such as roadsides, rice fields and coastal heath vegetation.

**Vernacular.**— Kachot nu (กระฉูดหนู) (South-eastern); Liphao yung (ลิผายุ้ง) (Peninsular).

**Specimens examined.**— *P. Pattarakulpisutti et al.* 220, 252, 265 (PSU).

**OPHIOGLOSSACEAE**

2. *Helminthostachys zeylanica* (L.) Hook., Gen. Fil. (Hooker) t. 47. 1840; Holttum, Rev. Fl. Malaya 2: 42, fig. 2. 1954; Takawa & K. Iwats. in Fl. Thailand. 3(1): 38. 1979.

Terrestrial; rhizome creeping, up to 5 mm in diam.; phyllomophore 30–35 cm long, glabrous. *Trophophyll* ca 20 by 30 cm, tripartite, each with 3–5 lobed; lobes lanceolate-oblong, 2.5–4.5 by 1.2–1.5 cm, chartaceous, glabrous, apex acute to obtuse, margin crenulate, base cuneate. *Sporophyll*: stalks 9–11.5 cm long, glabrous; spikes cylindrical, 6.5–10 by 0.4–0.8 cm, glabrous. *Sporangia* globose, ca 1 by 1 mm, glabrous.

**Thailand.**— Throughout Thailand.

**Distribution.**— From Sri Lanka and Assam to New Caledonia and Queensland.

**Ecology.**— On shady areas, rubber plantations and termite mounds in rice fields.

**Vernacular.**— Kut chong (กูดจ้อง), Kut sang (กูดซัง), Kut tin hung (กูดตีนหุ้ง), phak tin kwang (ผักตีนกวาง) (Northern); Tin nok yung (ตีนนกยุง) (South-eastern, Peninsular); Phak nok yung (ผักนกยุง) (Eastern).

**Specimen examined.**— *P. Pattarakulpisutti et al.* 471 (PSU).

## POLYPODIACEAE

**3. *Drynaria quercifolia* (L.) J. Sm., J. Bot. (Hooker) 3: 398. 1841; Holttum, Rev. Fl. Malaya 2: 182, fig. 88. 1954; Takawa & K. Iwats. in Fl. Thailand. 3(4): 546, pl. III. 1989.**

Epiphyte or lithophyte; rhizome creeping, 1.5–2 cm in diam., densely scaly; scales golden brown to dark brown, 5–18 by 1–1.5 mm, margin fimbriate. *Fronde*s simple, distinctly dimorphic. *Nest-leaves* sessile, ovate, 22–30 by 16–20 cm, coriaceous, glabrous, base obliquely cordate, margin shallowly lobed; lobed broadly deltoid to deltoid, 1.5–1.8 by 1–2 cm, apex obtuse, margin entire. *Foliage-leaves* pinnatifid; stipe ca 2 cm long, winged; densely scaly at base; scales as in rhizome; laminae narrowly oblong in outline, ca 80 by 30 cm, sub-coriaceous, glabrous, base attenuate, margin lobed to 5–8 mm from midvein; lobed linear-oblong, 15.5–20 by

2.8–3.5 cm, apex acuminate, margin entire. *Sori* two rows between adjacent mid veins, orbicular, up to 1.5 mm wide, glabrous. *Sporangia* up to 0.25 mm in diam.; stalk up to 1.5 mm long; annulus longitudinal, continuous. **Plate 2.B.**

**Thailand.**— Throughout Thailand.

**Distribution.**— Sri Lanka, India to Southern China and Indochina, Malesia to Fiji and Tropical Australia.

**Ecology.**— On tree-trunks, dry rocks or mossy rocks and on litter of decaying leaves in coastal heath vegetation.

**Vernacular.**— Kratae tai mai (กระแตไต่ไม้) (Central); Kut Kha hok (กูดขาฮอก), Chao-wa-na (เจ้าวะนะ), Phu-dong-khae (พุดดองแคะ) (Karen/Northern); Dao-ka-lo (เดากาโละ) (Malay/Peninsular); Bai nu Chang (ใบหูช้าง), Sabai nang (สไบนาง), Hua wao (หัวว่าว) (South-western); Sa-mong (สะโมง) (Suai/Surin).

**Specimen examined.**— *P. Pattarakulpisutti et al.* 283 (PSU).

**4. *Pyrrrosia piloselloides* (L.) M.G.Price, Kalikasan 3: 176. 1974.**— *Drymoglossum piloselloides* C. Presl, Tent. Pterid. 227 t. 10 f. 5. 6. 1836; Holttum, Rev. Fl. Malaya 2: 149, fig. 64. 1954; Takawa & K. Iwats. in Fl. Thailand. 3(4): 490, fig. 49.13–14. 1989.

Epiphyte; rhizome creeping, ca 1 mm in diam., densely scaly; scales peltate, dark brown on central portion with pale brown on margin, orbicular, ca 0.5 by 0.5 mm, margin fimbriate. **Fronde**s simple, distinctly dimorphic. **Sterile fronds:** stipe up to 5 mm long, densely scaly; scales as in rhizome; laminae oblong to elliptic, 2.5–4.5 by 1.2–1.5 cm, coriaceous, sparsely cover with stellate hairs to glabrescent, apex obtuse, margin entire, base attenuate. **Fertile fronds:** stipe up to 5 mm long; densely scaly; scales as in rhizome; laminae narrowly elliptic to linear, 7.3–11 by 0.6–0.7 cm, coriaceous, glabrous, apex obtuse, margin entire, base attenuate. *Sori* continuous along margin, up to 2 mm wide, covered with stellate hairs when young. *Sporangia*



up to 0.25 mm in diam.; stalk up to 0.5 mm long; annulus longitudinal, continuous.

**Plate 2. C.–D.**

**Thailand.**— NORTH-EASTERN: Nong Khai; EASTERN: Chiyaphum; CENTRAL: Nakhon Nayok, Bangkok; SOUTH-EASTERN: Chon Buri, Chanthaburi, Trat; SOUTH-WESTERN: Kanchanaburi; PENINSULAR: Chumphon, Krabi, Ranong, Surat Thani, Phangnga, Nakhon Si Thammarat, Trang, Songkhla, Satun, Narathiwat, Yala.

**Distribution.**— Himalayas, Indochina, Southern China and Malesia.

**Ecology.**— On tree-trunks or branches in not so dense forests.

**Vernacular.**— Klet nakkharat (เกล็ดนาคราช) (Central); Kip ma lom (กึบมาลอม) (Northern); Man hia (มันเหี้ย) (South-eastern).

**Specimen examined.**— *P. Pattarakulpisutti et al.* 219 (PSU).

**EUDICOTS**

**AMARANTHACEAE**

**5. *Alternanthera sessilis*** (L.) DC., Cat. Pl. Horti Monsp. 77. 1813; Hook. f. in Fl. Brit. India (J. D. Hooker) 4: 731. 1885; K. Larsen in Fl. Thailand. 5(4): 406, fig. 90.1–8, pl. XXV33. 1987.

Annual to short-live perennial herb, 8–20 cm high; stem erect, prostrate and creeping, hairy at nodes. **Leaves** simple, decussate; stipule absent; petiole up to 1 mm long, glabrous; blade linear-lanceolate to elliptic, 3–28 by 2–6 mm, chartaceous, sparsely hairy, apex obtuse, margin bluntly serrulate, base cuneate. **Inflorescences** axillary, head to spike, 4–6 mm in diam., sessile; rachis up to 3 mm long, villose; bracts ovate-lanceolate, ca 1 by 0.5 mm, glabrous, apex acuminate, margin entire. **Flowers** actinomorphic, ca 1 m in diam., sessile, glabrous; bracteoles ovate-lanceolate, 1 by 0.25–0.5 mm, glabrous, apex acuminate, margin entire. **Perianth** white, free, tepals 5, lanceolate-ovate, glabrous, 2–2.5 by 0.5–1 mm, apex acuminate,

margin entire. **Stamens** 3, connate at base; filaments ca 1 mm long, glabrous; anthers dorsifixed, 2-celled, ca 0.25 mm long, glabrous. **Ovary** superior, ca 1 mm in diam., glabrous, placentation apical, 1-loculed; style 1, ca 0.25 mm long, glabrous; stigma 1, capitate, ca 0.1 mm in diam., glabrous. **Fruit** green, heart-shaped, flattened, ca 2 by 2 mm, glabrous. **Seeds** orbicular, flattened, ca 0.75 by 0.75 mm, glabrous. **Plate 2.A.**

**Thailand.**— Throughout Thailand.

**Distribution.**— Cosmopolitan.

**Ecology.**— Very common in marshy areas, rice fields and waysides. Flowering and fruiting all year round.

**Vernacular.**— Prieo daeng (เปรี้ยวแดง) (Northern); Phakpet (ผักเป็ด), Phak pet khao (ผักเป็ดขาว), Phak pet thai (ผักเป็ดไทย) (Central).

**Specimen examined.**— *P. Pattarakulpisutti et al.* 408 (PSU).

## APOCYNACEAE

6. *Aganosma marginata* G. Don, Gen. Hist. 7. 77. 1837; Hook. f. in Fl. Brit. India (J. D. Hooker) 3: 663. 1882; Ridl., Fl. Malay. Penin. 2: 365. 1923; Backer & Bakh. f., Fl. Java (Spermatoph.) 2: 237. 1965; D. J. Middleton in Fl. Thailand. 7(1): 106, fig. 33. 1999.— *A. velutina* A. DC., Prodr. (DC.) 8: 434. 1844; Backer & Bakh. f., Fl. Java (Spermatoph.) 2: 238. 1965.

Scandent; flowering twig 2–3 mm in diam., lenticellate, sparsely hairy when young; sap white. **Leaves** simple, opposite; stipule absent; petiole 2–5 mm long, sparsely hairy; blade elliptic-oblong, 3.2–8 by 1.4–2.5 cm, sub-coriaceous, lower surface sparsely hairy, apex acuminate to obtuse, margin entire, base obtuse. **Inflorescences** axillary, cymes, 7–15-flowered; peduncle 1.1–2 cm long, glabrescent; bracts narrowly oblong to linear oblong, 3–5 by 1 mm, sparsely hairy, apex acute, margin entire. **Flowers** actinomorphic, 2–2.5 cm in diam.; pedicels up to 2 mm long, glabrescent; bracteoles narrowly deltoid, ca 1 by 0.25 mm, glabrescent, apex acute, margin entire. **Calyx** green, gamosepalous, campanulate, 5-lobed, glabrescent; tube ca

1 by 2 mm; lobes narrowly deltoid, 2.5–4.5 by 1.5–2 mm, apex acute, margin entire. **Corolla** white, gamopetalous, salverform, 5-lobed, glabrous; tube 6–7 by 2 mm; lobes linear-oblong, 1.3–1.4 by 2.5–3 mm, apex obtuse, margin entire. **Stamens** 5, connivent, epipetalous; anthers sessile, basifixed, 2-celled, ca 3 mm long, glabrous. **Disc** 5-lobed, ca 0.25 mm long, glabrous. **Ovary** superior, of 2 free carpels, ca 1 mm in diam., glabrous, placentation marginal, 1-loculed; style 1, ca 2 mm long, glabrous; pistil head 1, ellipsoid, ca 1 by 0.25 mm, glabrous. **Fruit** of paired follicles, green to brown, 49–66 by 0.5 cm, glabrous. **Seeds** not seen. **Plate 2.F.**

**Thailand.**— Throughout Thailand.

**Distribution.**— India, Nepal, Bhutan, Bangladesh, China, Myanmar, Indochina, Malaysia, Indonesia, and Philippines.

**Ecology.**— In the edge of flooded areas. Flowering and fruiting from March to April.

**Vernacular.**— Khrua sai ton (เครือไต้ตัน), Duadin (เดื่อดิน), Duanam (เดื่อน้ำ), Duakhruea (เดื่อเครือ) (Northern); Sai tan (ไต้ตัน) (Nakhon Ratchasima); Yan dueai bit (ย่านเดื่อขวิด) (Surat Thani); Dueai dip (เดื่อขวิด) (Krabi).

**Specimens examined.**— *P. Pattarakulpisutti et al.* 240, 436 (PSU).

**7. *Ichnocarpus frutescens* (L.) W. T. Aiton, Hort. Kew. (ed. 2) 2: 69. 1881; Hook. f. in Fl. Brit. India (J.D. Hooker) 3: 669. 1882; Ridl., Fl. Malay. Penin. 2: 364. 1923; Backer & Bakh. f., Fl. Java (Spermatoph.) 2: 239. 1965; D. J. Middleton in Fl. Thailand. 7(1): 88, fig. 36. 1999.— *I. ovatifolius* A. DC., Prodr. (DC.) 8: 435. 1844; Hook. f. in Fl. Brit. India (J.D. Hooker) 3: 670. 1882; Ridl., Fl. Malay. Penin. 2: 364. 1923.**

Vine; stem 2–3 mm in diam., sparsely hairy; sap white. **Leaves** simple, opposite; stipule absent; petiole 3–8 mm long, sparsely hairy; blade elliptic, 3–7 by 1.2–3.8 cm, sub-coriaceous, sparsely hairy, apex cuspidate, margin entire, base obtuse. **Inflorescences** terminal and axillary, panicle, many-flowered; peduncle 7–12

mm long, hairy; rachis 7–12 mm long, hairy; bracts deltoid, ca 1.5 by 1 mm, hairy, apex acute, margin entire. **Flowers** actinomorphic, ca 5 mm in diam.; pedicels 2.4 mm long, hairy; bracteoles deltoid, ca 1 by 1 mm, sparsely hairy, apex acute, margin entire. **Calyx** green, gamosepalous, campanulate, 5-lobed, hairy; tube 2–2.5 by 1 mm; lobes deltoid, 1 by 0.5–1 mm, apex obtuse, margin entire. **Corolla** white, gamopetalous, salverform, 5-lobed, hairy; tube 2–2.5 by 1 mm; lobes linear-lanceolate in outline, twisted, 4–5 by 1 mm, apex acute, margin entire. **Stamens** 5, connivent, epipetalous; filaments ca 0.25 mm long, glabrous; anthers basifixed, 2-celled, ca 1 mm long, glabrous. **Disc** 5-lobed, ca 1 mm long, glabrous. **Ovary** superior, of 2 free carpels, ca 0.75 mm in diam., hairy, placentation marginal, 1-loculed; style 1, ca 1 mm long, glabrous; pistil head 1, ellipsoid, ca 0.75 by 0.5 mm, glabrous. **Fruit** and **seeds** not seen. **Plate 2.G.**

**Thailand.**— Throughout Thailand.

**Distribution.**— From Sri Lanka, India to China, Philippines and Northern Australia.

**Ecology.**— In seasonally flooded areas and along rivers. Flowering and fruiting from August to January.

**Vernacular.**— Khrua chen (เครื่องเงิน) (Chiang Mai); Chai song (ชัยสง), Khrua sut (เครื่องชุด), Khrua sut daeng (เครื่องชุดแดง) (Loei); Thao yot daeng (เถายอดแดง) (Ang Thong); Hun nam (หุนน้ำ) (Saraburi); Thao wan daeng (เถาวัลย์แดง), Hua khwan (หัวขวาน) (Chon Buri); tao hai (เต่าไห้) (Trat).

**Specimen examined.**— *P. Pattarakulpisutti et al.* 165 (PSU).

**8. *Wrightia religiosa*** Benth. & Hook. f., Gen. Pl. (Bentham & Hooker. f.) 2(2): 713. 1876; Hook. f. in Fl. Brit. India (J.D. Hooker) 3: 653. 1882; Ridl., Fl. Malay. Penin. 2: 353. 1923; Backer & Bakh. f., Fl. Java (Spermatoph.) 2: 241. 1965; D. J. Middleton in Fl. Thailand. 7(1): 88. 1999.

Shrub, ca 1 m high; flowering twig 2–3 mm in diam., sparsely lenticellate, hairy when young. **Leaves** simple, opposite; stipules absent; petiole up to 2 mm long, hairy; blade obovate-lanceolate to narrowly oblong, 2–5 by 0.6–1.3 cm, chartaceous, glabrous, apex acuminate, margin entire, base cuneate. **Inflorescences** terminal, cymes, 3–11-flowered; peduncle 3–10 mm long, sparsely hairy; bracts narrowly deltoid, ca 1 by 0.5 mm, glabrous, apex acuminate, margin ciliate. **Flowers** actinomorphic, 1–2 cm in diam.; pedicels 6–17 mm long, glabrous; bracteoles narrowly deltoid, ca 0.5 by 0.25 mm, glabrous, apex acuminate, margin entire. **Calyx** green, gamosepalous, campanulate, 5-lobed, glabrous; tube ca 0.5 by 1 mm; lobes ovate-lanceolate, 0.75–1 by 0.5 mm, apex acute, margin ciliate. **Corolla** white, gamopetalous, rotate, 5-lobed, sparsely hairy; tube 2.5–3 by 1 mm; lobes elliptic, 8–10 by 4–6 mm, apex obtuse, margin entire. **Stamens** 5, connivent, epipetalous; filaments up to 2 mm long, glabrous; anthers basifixed, 2-celled, 4–5 mm long, hairy. **Ovary** superior, of 2 free carpels, ca 1 mm in diam., glabrous, placentation marginal, 1-loculed; style 1, 5–6 mm long, glabrous; pistil head 1, sub-globose, ca 1 by 0.5 mm, glabrous. **Fruit** and **Seeds** not seen. **Plate 2.H.**

**Thailand.**— NORTHERN: Chiang Mai, Kamphaeng Phet, Nakhon Sawan; NORTH-EASTERN: Khon Kaen; EASTERN: Surin; CENTRAL: Ayutthaya, Bangkok; SOUTH-EASTERN: Chon Buri, Rayong, Chanthaburi; PENINSULAR: Chumphon, Nakhon Si Thammarat, Trang, Songkhla.

**Distribution.**— Myanmar, Indochina, Malaysia and Philippines.

**Ecology.**— In seasonally flooded areas. Flowering and fruiting all year round.

**Vernacular.**— Pit-chong-wa (ปีดจงวา) (Khmer-Surin); Lak pa (หลักป่า) (Rayong); Mok son (โมกซ็อน), Mok ban (โมกบ้าน) (Central).

**Specimens examined.**— *P. Pattarakulpisutti et al.* 181, 202, 644 (PSU).

## ASTERACEAE

**9. *Eclipta prostrata*** (L.) L., Mant. Pl. Altera 286. 1771.— *E. alba* Hassk., Pl. Jav. Rar. 528; Miq. Fl. Ned. Ind. 2. 65. Hook. f. in Fl. Brit. India (J. D. Hooker) 3: 304. 1885.

Annual herb, 9–92 cm high; stem erect, prostrate and creeping, sparsely hairy. **Leaves** simple, decussate; stipule absent; sessile; blade narrowly lanceolate, 1.4–3 by 4–13 cm, sub-membranous, sparsely hairy, apex acute, margin bluntly serrulate, base attenuate. **Inflorescences** axillary and terminal, head, 6–13 mm in diam.; peduncle 0.4–5 cm; involucral bracts lanceolate to oblanceolate-oblong, 5–7 by 1.5–2.5 mm, sparsely hairy outside, apex acute, margin entire. **Ray flowers** pistillate or neutral, zygomorphic, 2–3 mm in diam., sessile, glabrous; pappus filiform, 2–3 mm long, hairy; corolla white, gamopetalous, ligulate, 4-lobed, glabrous; tube 0.75–1 by 0.2 mm; lobes unequal, 2–(1) one(s) indistinct and 2–(3) larger ones, linear, 2.5–3 by 0.25 mm, apex obtuse, margin entire. **Ovary** inferior, ca 0.25 mm in diam., glabrous, placentation basal, 1-loculed; style 1.5–2 mm long, glabrous; stigma 2, filiform, papillose. **Disk flowers** bisexual, actinomorphic, ca 1 mm in diam., sessile, glabrous; pappus as in ray flowers; corolla white, gamopetalous, campanulate, 4-lobed, glabrous; tube 0.75–1 by 0.5–0.75 mm; lobes deltoid, ca 0.5 by 0.25 mm, apex acute, margin entire. **Stamens** 4, connate into androphore, ca 1 mm long; anthers 2-celled, extrorse, ca 0.75 mm long, glabrous. **Fruit** an achene, oblanceolate-oblong, flattened, 2.75–3 by 0.75–1 mm, glabrous. **Seed** not seen. **Plate 3.A.**

**Thailand.**— Throughout Thailand.

**Distribution.**— Tropics and Subtropics.

**Ecology.**— Very common in marsh areas, rice fields and waysides. Flowering and fruiting all year round.

**Vernacular.**— Ka meng (กระเม็ง), Ka meng tua mia (กระเม็งตัวเมีย), Khat meng (คัตเม็ง) (Central); Bang-ki-chao (บังกีเช่า) (Chinese); Yasap (หญ้าสับ), Hom kiao (ฮ่อมเกี้ยว) (Northern).

**Specimens examined.**— *P. Pattarakulpisutti et al.* 350, 410 (PSU).

### BALSAMINACEAE

**10. *Hydrocera triflora*** (L.) Wight & Arn., Prodr. Fl. Ind. Orient. 1: 140. 1834; Hook. f. in Fl. Brit. India (J. D. Hooker) 1: 483. 1875.— *H. angustifolia* Blume, Bijdr. Fl. Ned. Ind. 5: 241. 1825; Ridl., Fl. Malay. Penin. 1: 340. 1922.

Annual herb, up to 40 cm high; stem succulent, angled, glabrous. **Leaves** simple, alternate, sessile; blade linear-elliptic to narrowly elliptic, 15–23 by 1–2 cm, membranous, glabrous, apex acuminate, margin serrate, base attenuate. **Inflorescences** axillary, short raceme, usually 2-flowered; peduncle 5–6 mm long, glabrous; rachis 1–2 mm long, glabrous. **Flowers** zygomorphic, ca 15 mm in diam.; pedicels 6–9 mm long, glabrous; bracts linear-oblong, 2–7 by 1 mm, glabrous, apex acute, margin entire. **Calyx** petaloid, pink, free, sepals 5, glabrous; upper lateral pair elliptic, ca 7 by 2 mm, apex obtuse, margin entire; lower lateral pair elliptic, ca 10 by 5 mm, apex obtuse, margin entire; lower petal elliptic, ca 12 by 7 mm, apex acute, margin entire, spur ca 4 by 1 mm long, apex obtuse, curved. **Corolla** pink, free, petals 5, glabrous; dorsal petal orbicular, ca 10 by 9 mm, apex acute, margin entire; upper-lateral pair falcate-elliptic, ca 10 by 5 mm, apex obtuse, margin entire; lower-lateral pair obovate-lanceolate in outline, ca 2 by 0.5 cm, glabrous, apex obtuse, crenate at upper part, base clawed. **Stamens** 5, connate on upper part of filaments and anthers and enclose gynoecium; filaments ca 7 mm long, glabrous; anthers 2-celled, ca 2 mm long, glabrous. **Ovary** superior, ca 2 mm in diam., glabrous, placentation axile, 5-loculed; style absent; stigma 1, conical, ca 1 mm long, glabrous. **Fruit** a berry, dark red, sub-globose with 5-blunt angled, 8–10 by 7–10 mm, glabrous. **Seeds** not seen.

**Plate 3.B.**

**Thailand.**— PENINSULAR: Satun, Trang.

**Distribution.**— Southern India, Sri Lanka, Southern China, Indochina, Malaysia and Java.

**Ecology.**— In marshy areas and rice fields, disappear in dry period. Flowering and fruiting depend on inundation period.

**Vernacular.**— Kaeo nam (แก้วน้ำ) (Nakhon Ratchasima, Prachin Buri), Thian na (เทียนนา), Thian nam (เทียนน้ำ) (Central); I-na-o (อินนาโอย์) (Malay-Narathiwat).

**Specimens examined.**— *P. Pattarakulpisutti et al.* 142, 370 (PSU).

## BIGNONIACEAE

**11. *Dolichandrone columnaris*** Santisuk, Bull. Mus. Natl. Hist. Nat., B, Adansonia Sér. 4, 7(1): 100. 1985; Santisuk in Fl. Thailand. 5(1): 54, fig. 22, pl.III-1. 1987.

Tree, up to 20 m high, dbh ca 15 cm; bark grey; branchlets 4–6 mm in diam., glabrous. **Leaves** imparipinnate, alternate; stipule absent; petiole 3–4 cm long, punctate; rachis 1.5–5 cm long, punctate; petiolules 0.7–2 cm long, punctate; leaflets 3–7, ovate-lanceolate to ovate, 4–9.5 by 2–4.2 cm, chartaceous, upper surface punctate, lower surface sparsely covered with large glands, apex acuminate, margin entire, base obtuse. **Inflorescences** terminal, very short raceme, 1–3-flowered. **Flowers** zygomorphic, ca 3.5 mm in diam.; pedicels 1–1.5 cm long, glabrous; bracts narrowly elliptic, ca 2 by 1 mm, glabrous, apex acute, margin ciliolate. **Calyx** reddish green, connate into spathaceous, obovate, ca 4.2 by 2.4 cm, glabrous, apex acute, margin entire. **Disc** annular, ca 2 mm long, glabrous. **Corolla** white, gamopetalous, funnel form with long-narrow basal tube, 5-lobed, glabrous; basal tube 9–11 by 0.4 cm; upper tube campanulate, ca 2 by 1.8 cm; lobes orbicular, ca 1.5 by 0.8 cm, apex obtuse, margin crisped. **Stamens** 4, didynamous, free; filaments ca 12 mm long in shorter stamens and ca 20 mm long in longer ones, glabrous; anther basifixed, 2-celled, ca 5 mm long, glabrous. **Ovary** superior, ca 2 mm in diam., glabrous, placentation axile, 2-loculed; style 1, ca 12 cm long, glabrous; stigma bilobed, 5 by 2



mm, glabrous. **Fruit** a silique brown, linear with tapering end, 25–35 by 1.5–1.8 cm, glabrous. **Seeds** thin, 2–3 by 6–7 mm including wing, glabrous. **Plate 3.C–D.**

**Thailand.**— PENINSULAR: Surat Thani, Nakhon Si Thammarat, Phangnga, Trang, Satun.

**Distribution.**— Cambodia, Southern Vietnam and Northernmost Malaysia.

**Ecology.**— Usually found in rice fields. Flowering from April to August, fruiting June to March.

**Vernacular.**— Khae na (แคณา), Khae thung (แคทุ่ง), Khae yot dam (แคยอดดำ) (Peninsular).

**Specimen examined.**— *P. Pattarakulpisutti et al* 268 (PSU).

## BORAGINACEAE

**12. *Heliotropium indicum*** L., Sp. Pl. 1: 130. 1753; Ridl., Fl. Malay. Penin. 2: 441. 1923; Backer & Bakh. f., Fl. Java (Spermatoph.) 2: 462. 1965; Rield, in Fl. Males., Ser. 1, Spermat. 13: 105, fig. 7. 1997.

Annual herb, up to 60 cm high, covered with irritant bristles and short hairs. **Leaves** simple, alternate; petiole 1.1–2.5 cm long, covered with irritant bristles and short hairs; blade ovate, 2–11 by 0.9–5 cm, membranous, sparsely hairy, apex acute, margin crenulate, base truncate with long decurrent. **Inflorescences** terminal, spike-like, branched; peduncles 2–3 cm long, covered with irritant bristles and short hairs; rachis 8–13 cm long, covered with irritant bristles and short hairs; bract absent. **Flowers** actinomorphic, ca 3 mm in diam., sessile; bracteole absent. **Calyx** light green, persistent, connate with short tube, 5-lobed, covered with irritant bristles; tube very short; lobes narrowly lanceolate, 3–4 by 1 mm, apex acuminate, margin serrate. **Corolla** pale purple with pale orange at throat, gamopetalous, salverform, 4–5-lobed, hairy outside; tube ca 4 by 1 mm; lobes orbicular, ca 2 by 0.5 mm, glabrous, apex acute to obtuse, margin entire. **Stamens** 4, free, epipetalous; filaments very short;

anthers dorsifixed, 2-celled, ca 1 mm long, glabrous. **Ovary** superior, ca 0.5 mm in diam., glabrous, placentation axile, 4-loculed; style 1, ca 0.5 mm long, glabrous; stigma 1, capitate, ca 0.5 mm in diam., glabrous. **Fruit** a capsule septicidal dehiscent, broadly ovoid, ca 3 by 3 mm, glabrous. **Seeds** ellipsoid, ca 1 by 1 mm, glabrous. **Plate 3.E.**

**Thailand.**— Throughout Thailand.

**Distribution.**— Probably a native of tropical America, now widespread throughout the Tropics.

**Ecology.**— Rice fields, roadsides and disturbed areas. Flowering and fruiting from March to May.

**Vernacular.**— Ku-no-ka-mo (กุนอกาโม) (Malay-Pattani); Phak phaeo khao (ผักแพวขาว) (Kanchanaburi); Ya nguang chang (หญ้างวงช้าง) (General); Ya nguang chang noi (หญ้างวงช้างน้อย) (Northern).

**Specimen examined.**— *P. Pattarakulpisutti et al 235* (PSU).

## CAMPANULACEAE

**13. *Lobelia alsinoides*** Lam., Encycl. (Lamarck) 3(2): 588. 1792; Moeliono & Tuyn in Fl. Males., Ser. 1, Spermat. 6(1): 498. 1960.

Annual herb, up to 30 cm high; stem erect, trigonous, glabrous. **Leaves** simple, alternate; stipule absent; sessile; blade ovate, narrowly elliptic to linear-elliptic, 12–20 by 3–5 mm, sub-membranous, glabrous, apex obtuse, margin serrulate, base obtuse. **Flowers** solitary, axillary, zygomorphic, 3–4 mm in diam.; peduncle 3–25 mm long, glabrous; bracts subulate, ca 0.5 by 0.25 mm long, glabrous, apex acute, margin entire. **Calyx** maroon, gamosepalous, campanulate, 5-lobed, glabrous; tube ca 1 by 1 mm; lobes linear-oblong, 2–2.5 by 0.25 mm, apex acuminate, margin entire. **Corolla** violet with white blotches on lower lip, gamopetalous, bilabiate, 2-lobed, glabrous; tube 3–4 by 2 mm; upper lip oval in outline, ca 3 by 3 mm, apex deeply bilobed, margin entire; lower lip 3-lobed, each lobe sub-equal, elliptic-oblong, ca 3 by

2 mm, apex acute, margin entire. **Stamens** 5, connate into androphore, 4–5 mm long, glabrous; anthers extrorse, 2-celled, ca 1.5 mm long, glabrous. **Ovary** inferior, ca 2 mm in diam., glabrous, placentation axile, 2-loculed; style 1, 5–6 mm long, glabrous; stigma bilobed, flattened, glabrous. **Fruit** a capsule septicidal dehiscent, ovoid, ca 4 by 2 mm, glabrous. **Seeds** ellipsoid to ovoid, ca 0.5 by 0.25 mm, trigonous, glabrous.

**Plate 3.F.**

**Thailand.**— NORTH-EASTERN: Loei; CENTRAL: Chai Nat; PENINSULAR: Trang, Satun, Songkhla.

**Distribution.**— Sri Lanka through Southern China and Southeast Asia.

**Ecology.**— In marshy areas, rice fields and waysides. Flowering and fruiting all year round.

**Vernacular.**— Sadoa din (สะเดาดิน) (Chai Nat); (Ya phak bia) (Loei).

**Specimens examined.**— *P. Pattarakulpisutti et al.* 470 (PSU).

## COMBRETACEAE

**14. *Combretum trifoliatum*** Vent., Choix Pl. t. 58. 1808; C .B. Clarke, in Hook. f., Fl. Brit. India (J. D. Hooker) 2: 454. 1878; Nanakorn, Thai Forest Bull., Bot. 16: 167, fig. 70. 1986.

Scandent, up to 3 m high; flowering twig 1–3 mm in diam., glabrous. **Leaves** simple, opposite; stipule not seen; petiole 3–5 cm long, glabrous; blade narrowly elliptic, 6.2–11.5 by 2.2–4.5 cm, coriaceous, glabrous, apex acute, margin entire, base truncate to obtuse. **Inflorescences** in two types, axillary spike and terminal panicle; peduncle 1.3–2.5 cm long, hairy; rachis 3.5–7 cm long, hairy; bract not seen. **Flowers** actinomorphic, 2–3 mm in diam., sessile; bracteole not seen. **Calyx** yellowish white, gamosepalous, urceolate, 5-lobed, hairy; tube ca 2 by 1 mm; lobes deltoid, ca 1 long, apex acuminate, margin entire. **Corolla** yellowish white, free, petals 5, narrowly elliptic, ca 10 by 1 mm, hairy, apex acuminate, margin entire. **Stamens** 10, free; filaments 4–5 mm long, glabrous; anthers dorsifixed, 2-celled, ca

0.25 mm long, glabrous. **Disc** hairy. **Ovary** inferior, ca 1 mm in diam., hairy, placentation apical, 1-loculed; style 1, 5–6 mm long, glabrous; stigma 1, punctiform. **Fruit** a samara, green to brown, ellipsoid with 5 winged; 2.8–3.2 by 1 cm, glabrous; wings 3–5 mm board. **Seed** not seen. **Plate 4.A.**

**Thailand.**— Throughout Thailand.

**Distribution.**— Indochina, Peninsular Malaysia and Java.

**Ecology.**— On seasonally inundated areas, usually secondary vegetation and open areas, old rice fields. Flowering from January to June. Fruiting from March to August.

**Vernacular.**— Khot sang (คดสัง), Yaan tut (ย่านตุต), (Surat Thani); Chut (จูด) (Peninsular); (เบน) (Khon Kaen); Puei (เปื้อย) (Nakhon Phanom); Yaa yotdam (หญ้ายอดดำ) (Northern).

**Specimen examined.**— *P. Pattarakulpisutti et al.* 201 (PSU).

**15. *Terminalia calamansanay*** Rolfe, J. Linn. Soc., Bot. 21: 310. 1884; Nanakorn, Thai Forest Bull., Bot. 15: 837, fig. 39. 1985.

Deciduous tree, up to 15 m high, dbh up to 20 cm; bark light brown to grey, vertically cracked; flowering twig 2–4 mm in diam., glabrous. **Leaves** simple, alternate; stipules ovate-lanceolate, ca 2 by 1 mm, hairy, apex acute, margin entire; petiole 2–3 cm long, glabrous; blade elliptic to obovate, 6–13 by 2.5–6 cm, coriaceous, glabrous, apex acuminate, margin entire, base cuneate. **Inflorescences** axillary, spike; peduncle 1–1.5 cm long, hairy; rachis 9–12 cm long, hairy; bract not seen. **Flowers** actinomorphic, strongly foetid, 3–4 mm in diam., sessile; bracteoles linear, ca 3–4 by 0.5 mm, hairy, apex acuminate, margin entire. **Calyx** yellowish green, gamosepalous, campanulate, 5-lobed, hairy; tube ca 2 mm in diam.; lobes recurved, deltoid, ca 2 by 1 mm, apex acute, margin entire. **Corolla** absent. **Stamens** 10, free, filaments, 3–4 mm long; anthers versertile, 2-celled, ca 0.5 mm long, glabrous. **Disc** lobed, hairy. **Ovary** inferior, ca 1 mm in diam., hairy, placentation apical, 1-loculed; style 1, up to 2 mm long, sparsely hairy; stigma 1, punctiform. **Fruit**

a samara, green to brown, 2-winged, 5–6.5 by 1.3–1.5 cm, hairy; trigonal 8–10 by 5–8 mm. *Seed* not seen. **Plate 4.B.**

**Thailand.**— NORTHERN: Lampang, Phichit, Nakhon Sawan; EASTERN: Surin; SOUTH-EASTERN: Chon Buri, Chanthaburi, Trat; CENTRAL: Saraburi, Nakhon Nayok, Nakhon Pathom; SOUTH-WESTERN: Kanchanaburi, Uthai Thani; PENINSULAR: Trang, Chumphon, Ranong, Krabi, Surat Thani, Satun.

**Distribution.**— Indochina, Peninsular Malaysia, Philippines, Celebes and New Guinea.

**Ecology.**— In deciduous forests, fringe areas of seasonally inundated areas and mound in rice fields. Flowering from November to December, fruiting from December to January.

**Vernacular.**— Khee mot (ขี้มอด) (Nakhon Pathom); Taa lon (ตาโหล่น) (Satun); Teen nok (ตีนนก) (Chanthaburi); Sakunee (สกุณี) (Ratchaburi); Prakham khee khwaai (ประกาศ้าคักวาย) (Peninsular); Haen daeng (แห่นแดง) (Northern); Haen (แห่น) (Nakhon Sawan, Chumphon).

**Specimens examined.**— *P. Pattarakulpisutti et al.* 557, 639 (PSU).

## CONVOLVULACEAE

**16. *Aniseia martinicensis*** (Jacq.) Choisy, Mém. Soc. Phys. Genève 8: 66. 1837; Ridl., Fl. Malay. Penin. 2: 456. 1923; Backer & Bakh. f., Fl. Java (Spermatoph.) 2: 488. 1965; Nasongkhla & Khunwasi, Thai Forest Bull., Bot. 20: 4, fig. 1, pl. I. 1993.

Vine; stem 1–2 mm in diam., sparsely hairy. **Leaves** simple, alternate; petiole 2–7 mm long, sparsely hairy; blade narrowly oblong, oblong to oblanceolate, 2.3–6.5 by 0.5–2.7 cm, chartaceous, sparsely hairy, apex mucronate, margin entire, base cuneate. **Inflorescences** axillary, cyme, 1–2-flowered; peduncle 1.5–2.5 cm long, hairy. **Flowers** actinomorphic, ca 1.5 cm in diam.; pedicels 4–7 mm long, hairy; bracts narrowly lanceolate, 1–2 by 0.5 mm, hairy, apex acute, margin entire. **Calyx** green, free, sepals 6, unequal, sparsely hairy; two outermost sepals larger, ovate-

lanceolate to ovate, 13–18 by 7 mm, apex acuminate, margin entire; the third obliquely ovate, ca 15 by 5–6 mm, apex acuminate, margin entire; innermost ones smaller, lanceolate, 1–1.1 by 2–3 mm, apex acuminate, margin entire. **Corolla** white with midpetaline band yellowish, gamopetalous, funnellform, 5-lobed, sparsely hairy outside; tube 1.5–1.7 by 1.5 cm; lobes indistinct. **Stamens** 4, free, epipetalous; filaments 3–4 mm long, hairy at base; anthers dorsifixed, 2-celled, ca 2 mm long, glandular. **Ovary** superior, ca 1 mm in diam., glabrous, placentation axile, 2-loculed; style 1, ca 1 cm long, glabrous; stigma bilobed. **Fruit** and **Seeds** not seen. **Plate 4.C.**

**Thailand.**— EASTERN: Nakhon Ratchasima, Ubon Ratchathani; SOUTH-WESTERN: Prachuap Khiri Khan; CENTRAL: Chi Nat, Sing Buri, Saraburi, Ayutthaya, Nakhon Nayok, Pathum Thani, Bangkok; SOUTH-EASTERN: Chachoengsao, Chanthaburi; PENINSULAR: Surat Thani, Trang, Songkhla, Pattani.

**Distribution.**— Throughout the Tropics.

**Ecology.**— In moist and open areas, on rice fields and roadsides. Flowering and fruiting all year round.

**Vernacular.**— Ching cho (จิงจ้อ) (Bangkok).

**Specimens examined.**—*P. Pattarakulpisutti et al.* 236, 244–1 (PSU).

## DILLENIACEAE

17. *Dillenia hookeri* Pierre, Fl. Forest. Cochinch. t. 5. 1879; Hooglang. in Fl. Thailand 2(2): 102. 1972.

Shrub, 1–2 m high; young branches densely hairy. **Leaves** simple, alternate; stipule absent; petiole 1.5–3 cm long, winged, densely hairy; blade oblanceolate, 9.5–16 by 3.3–9 cm, coriaceous, upper surface sparsely hairy, lower surface densely hairy, apex obtuse, margin entire, base attenuate. **Flowers** solitary, terminal, actinomorphic, 6–7 cm in diam.; peduncle 6–7 cm long, densely hairy; bracts linear-oblong, 2–3 by 0.7 cm, densely hairy outside, apex obtuse, margin entire. **Calyx** light green, free, sepals 5, orbicular to broadly ovate, 1.3–1.4 by 1.1–1.3 cm,

densely hairy outside, apex obtuse, margin entire. *Corolla* yellow, free, petals 5, broadly ovate to oblanceolate, 2.5–3 by 1.3–2 cm, glabrous, wrinkled, apex obtuse, margin entire, base cuneate. *Stamens* numerous, free; filaments 1–4 mm, glabrous; anthers basifixed, 2-celled, 4–5 mm long, glabrous. *Ovary* superior, 4–6 free carpels, coherent, ca 10 by 1 mm, glabrous, placentation marginal; style 1, 6–10 mm long, glabrous; stigma punctiform. *Fruit* dry, indehiscent, enclosed by enlarged sepals, globose, ca 2 cm in diam., including sepals. *Seeds* globose, laterally flattened, ca 4 by 3 mm, glabrous. *Plate 4.D.*

**Thailand.**— NORTHERN: Phitsanulok; NORTH-EASTERN: Nakhon Ratchasima, Si Sa Ket, Ubon Ratchatani; SOUTH-EASTERN: Chanthaburi, Trat; PENINSULAR: Surat Thani, Trang, Songkhla, Satun.

**Distribution.**— Indochina.

**Ecology.**— In secondary vegetations in seasonally flooded areas. Flowering from May to June. Fruiting from May to August.

**Vernacular.**— San din (सानดิน) (General); San noi (सानน้อย) (Northern); Kaplao (กะเปล้า) (Northern/Mon); San bat (सानบาท) (Eastern); Phlu sabat (พลูสะบาท) (Eastern/Khmer); San (सान) (Eastern, Peninsular); San tia (सानเตี้ย) (South-eastern); San tao (सानเต้า), San thung (सानทุ่ง) (Peninsular).

**Specimens examined.**— *P. Pattarakulpisutti et al.* 401 (PSU); *Supatra* 10 (PSU).

**18. *Tetracera loureiri*** (Finet & Gagnep.) Pierre ex Craib; Hooglang. in *Fl. Thailand* 2(2): 107. 1972.— *T. fragrans* Ridl., Ridl., *Fl. Malay. Penin.* 1: 6. 1922.

Woody vine; young branches sparsely hairy. *Leaves* simple, alternate; petiole 4–5 mm long, sparsely hairy; blade elliptic to oblong, 9–12.5 by 3.8–5.5 cm, coriaceous, punctate, lower surface sparsely hairy, apex acute, margin serrate, base cuneate. *Inflorescences* terminal, panicle, up to 40 flowered; peduncle 2.8–5 cm long, sparsely hairy; rachis 5.5–17 cm long, sparsely hairy; bracts oblanceolate, 7–17 by 2–

4 mm, sparsely hairy, apex acute, margin serrate. *Flowers* actinomorphic, 1–1.2 cm in diam.; pedicel 2–4 mm long, sparsely hairy; bracteoles oblanceolate, 2–4 by 1–2 mm, sparsely hairy, apex acute, margin serrate. *Calyx* light green, free, sepals 5, broadly elliptic to elliptic, 5–6 by 3–4 mm, punctate, apex obtuse, margin ciliolate. *Corolla* white, free, petals 3, elliptic to broadly elliptic, 6–7 by 4–5 mm, glabrous, apex obtuse, margin ciliolate, base cuneate. *Stamens* numerous, free; filaments 3–6 mm, glabrous; anthers basifixed, 2-celled, very small, glabrous. *Ovary* superior, 2–3 free carpels, ca 1 mm in diam., glabrous, placentation marginal; style 1, 3–4 mm long, stigma punctiform. *Fruit* and *Seed* not seen. **Plate 4.E.**

**Thailand.**— EASTERN: Nakhon Ratchasima, Ubon Ratchathani; CENTRAL: Bangkok; SOUTH-EASTERN: Prachin Buri, Chon Buri, Chanthaburi, Trat; SOUTH-WESTERN: Prachuap Khiri Khan; PENINSULAR: Surat Thani, Phuket, Nakhon Si Thammarat, Trang, Phatthalung, Songkhla, Satun, Pattani.

**Distribution.**— Vietnam, Cambodia and Malay Peninsula.

**Ecology.**— In seasonally flooded areas, old rice fields and coastal heath. Flowering and fruiting all year round.

**Vernacular.**— Lin raet (ลิ้นแเรด) (Eastern); Rot Sukhon (รสสุคนธ์), Sukhontharot (สุคนธ์รส), Matat khrua (มะตาดเครือ) (Central); Norakhon (นรคนธ์), Borakhon (บอระคน), Orakhon (อรคนธ์), Saowakhon (เสาวคนธ์) (South-eastern); Kapot bai luam (กะปดใบเลื่อม) (South-western); Pot namman (ปดน้ำมัน), Pot lun (ปดลิ้น), Pot khai (ปดคาย), Yan pot (ย่านปด) (Peninsular); Pala (ปะละ), Sapanla (สะปัลละ) (Peninsular/Malay).

**Specimens examined.**— *P. Pattarakulpisutti et al.* 237, 414 (PSU).

## DROSERACEAE

**19. *Drosera indica* L.,** Sp. Pl. 1: 282. 1753; C. B. Clarke in Fl. Brit. India (J. D. Hooker) 2: 424. 1879; Ridl., Fl. Malay. Penin. 1: 688. 1922; K. Larsen in Fl. Thailand. 5(1): 68, fig. 24:2, pl. IV2. 1987.



Insectivorous herb, 8–10 cm long, covered with glandular hairs throughout. **Leaves** simple, spiral, sessile; blade modified to insectivorous leaf, filiform, 1.5–2.5 by 1 mm, covered with viscid-stalked glands, apex circinate. **Inflorescences** lateral, raceme; peduncle 1–1.5 cm long, covered with glandular hairs; rachis 1.3–1.5 cm long, covered with glandular hairs. **Flowers** actinomorphic, ca 5 mm in diam.; pedicels 5–7 mm long, covered with glandular hairs; bracts filiform, 1.5–2 mm long, covered with glandular hairs. **Calyx** light green, persistent, gamosepalous, campanulate, 5-lobed, covered with glandular hairs; tube ca 1 by 2 mm; lobes lanceolate, 1.5–2 by 1 mm, apex acute, margin entire. **Corolla** purple, free, petals 5, obovate, ca 4 by 3 mm, glabrous, apex obtuse, margin entire. **Stamens** 5, free; filaments ca 2 mm long, glabrous; anthers basifixed, 2-celled, ca 0.5 mm long, glabrous. **Ovary** superior, ca 1 mm in diam., glabrous, placentation axile, 3-loculed; styles 3, ca 1.5 mm long, glabrous; stigma bifid capitate, ca 0.1 mm in diam., glabrous. **Fruit** a capsule sub-globose, ca 2 by 2 mm, glabrous. **Seeds** not seen. **Plate 4.F.**

**Thailand.**— Throughout Thailand.

**Distribution.**— Tropical Africa to tropical Asia, Japan, Australia.

**Ecology.**— Usually in open-moist sand or moist soils. Flowering and fruiting all year round.

**Vernacular.**— Ya nam khang (หญ้าน้ำค้าง) (North-eastern).

**Specimens examined.**— *P. Pattarakulpisutti et al.* 374, 498 (PSU).

## EUPHORBIACEAE

**20. *Croton caudatus*** Geiseler, *Croton*. Monogr. (Geiseler): 73. 1807; Hook. f. in Fl. Brit. India (J. D. Hooker) 5: 388. 1887; Ridl., Fl. Malay. Penin. 3: 259. 1924; Airy Shaw, Kew Bull. 26(2): 245. 1972; Whitmore, Tree Fl. Mal. 2: 85. 1973; Welzen & Chayam. in Fl. Thailand. 8(1): 198. 2005.— *C. caudatus* var. *malaccanus* Hook. f. in

Fl. Brit. India (J. D. Hooker) 5: 389. 1887.— *C. laccifer* L., Airy Shaw, Kew Bull. 26(2): 248. 1972.

Straggling shrub, up to 3 m high; flowering twigs ca 2 mm in diam., densely covered with stellate hairs when young; monoecious. **Leaves** simple, alternate; stipules narrowly deltoid, 2–3 by 1 mm, densely covered with stellate hairs, apex caudate, margin entire; petiole 1–3 cm long, densely covered with stellate hairs; blade ovate, elliptic to oblong, 4–11 by 2–5.5 cm, membranous to chartaceous, densely covered with stellate hairs, apex obtuse to acute, margin biserrate, base cordate to truncate. **Inflorescences** terminal, raceme; basal part pistillate, apical part staminate; peduncle 8–15 mm long, densely covered with stellate hairs; rachis 7–14 cm long, densely covered with stellate hairs; bracts filiform, ca 3–4 mm long, densely hairy. **Flowers** unisexual, actinomorphic; calyx connate at base, 6-lobed, hairy outside; corolla absent in pistillate ones, in staminate petals 5, free, glabrous; bracteoles filiform, ca 3–4 mm long, densely hairy. **Staminate flowers** ca 7 mm in diam.; pedicels up to 7 mm long, hairy; calyx green, tube very short, lobes deltoid, ca 2 by 2 mm, apex acute, margin entire; petals brownish green, oblanceolate, 2–3 by 1 mm, apex obtuse, margin covered with long hairs; receptacle pilose; stamens numerous, free, filament ca 2.5 mm long, glabrous, anthers basifixed, 2-celled, ca 1.5 mm long, glabrous. **Pistillate flowers** ca 7 mm in diam.; pedicels ca 2 mm, hairy; calyx green, persistent, tube very short, lobes oblong, 4–5 by 2 mm, apex acute, margin entire; ovary superior, ca 2 mm in diam., densely hairy, placentation axile, 3-loculed, styles 6, 5–7 mm long, glabrous, stigma 6, punctiform, glabrous. **Fruit** a capsule, loculicidal dehiscent, reddish brown, sub-globose, 1.2–1.5 cm in diam., densely covered with stellate hairs. **Seeds** not seen. **Plate 4.G.**

**Thailand.**— Throughout Thailand.

**Distribution.**— Sri Lanka, India, Bhutan, Bangladesh, Indochina and Malesia.

**Ecology.**— In open areas, roadsides, forest edges, old rice fields and secondary vegetations along river floodplains. Flowering from March to May, fruiting from April to June.

**Vernacular.**— Krado hot dai khon (กระดอหดไบน) (Chanthaburi); Kho khlan (ไคคลาน) (Nakhon Ratchasima); Prink (ปริง) (Trang); Kho khlan bai khon (ไคคลานไบน) General; Ku-ro-pri-ya (กูเราะประยยะ) (Malay-Narathiwat).

**Specimens examined.**— *P. Pattarakulpisutti et al.* 215, 248, 257, 347, 357, 367, 384, 389 (PSU); *J.F. Maxwell* 84–186, 86–262, 86–500 (PSU); *P. Sirirugsa* 435 (PSU); *L. Leeratiwong* 2002–68 (PSU).

**21. *Shirakiopsis indica*** (Willd.) Esser, *Blumea* 44(1): 185. 1999; Welzen & Chayam. in *Fl. Thailand*. 8(2): 555, fig. 82, pl. XXIX3. 2007.— *Sapium indicum* Willd., Whitmore, *Tree Fl. Mal.* 2: 128. 1973

Tree, up to 25 m high, dbh up to 40 cm; bark dark brown; flowering twigs 2–3 mm in diam., glabrous; monoecious. **Leaves** simple, alternate; stipules ovate-deltoid, ca 2 by 1 mm, apex obtuse, margin ciliate; petiole 0.8–1.2 cm long, glabrous; blade narrowly elliptic to elliptic, 5.8–9.5 by 2.5–3.5 cm, coriaceous, glabrous, apex acute, margin crenate, base cuneate. **Inflorescences** terminal; spike-like thyrse, 6–8 cm long; consist of 1 pistillate at the base and the rest of staminate flowers, base with a pair of glands between staminate flowers, ca 2 by 1 mm; bracts deltoid, ca 2 by 2 mm, hairy, apex acute, margin entire. **Flowers** unisexual, actinomorphic; calyx free, sepals 3, glabrous; corolla absent; bracteoles deltoid, ca 1 by 1 mm, glabrous, apex acuminate, margin ciliate. **Staminate flowers** ca 1 mm in diam.; pedicels up to 2 mm, glabrous; sepals yellowish green, deltoid, ca 1 by 1 mm, glabrous, apex obtuse, margin ciliate; stamens 3, free, filaments ca 1 mm long, glabrous, anthers basifixed, 2-celled, ca 0.25 mm long, glabrous. **Pistillate flowers** ca 2 mm in diam.; pedicels up to 3 mm, glabrous; sepals light green, ovate-lanceolate; ca 2 by 1 mm, apex acuminate, margin ciliate; ovary superior, ca 1 mm in diam., hairy, placentation axile, 3-loculed; style 1, ca 1 mm long, glabrous, stigma 3, filiform, ca 2

mm long, hairy. **Fruit** black, globose, 2.5–2.8 by 2.5 cm, glabrous. **Seeds** elliptic, 8–15 by 3–7 mm, glabrous.

**Thailand.**— CENTRAL: Bangkok; PENINSULAR: Surat Thani, Nakhon Si Thammarat, Phattalung, Trang, Satun, Pattani, Narathiwat.

**Distribution.**— Sri Lanka, India, Malesia, Caroline Islands and Solomon Island.

**Ecology.**— Along rivers, seasonally flooded areas and peat swamp forests. Flowering and fruiting all year round.

**Vernacular.**— Krahut (กระหูด), Samo thale (สมอทะเล) (Central); Kue-ro (กือเราะ), Khue rak (ค็ือรั๊ก), Ku-ra (กูระ), Ku-la (กูลา) (Malay-Peninsular).

**Specimens examined.**— *P. Pattarakulpisutti et al.* 360, 653 (PSU).

## FABACEAE

**22. *Derris elliptica*** Benth., J. Proc. Linn. Soc., Bot. 4 (Suppl.): 111. 1860; Ridl., Fl. Malay. Penin. 1: 597. 1922

Woody climber; bark reddish brown, lenticellate, glabrous; branchlets 3–5 mm in diam., densely hairy. **Leaves** imparipinnate, alternate; stipules broadly deltoid, 4–5 by 4 mm, densely hairy, apex acute, margin entire; petiole 4–6 cm long, sparsely hairy; rachis 6–9 cm long, sparsely hairy; petiolules 5–8 mm long, densely hairy; leaflets 9–11, obovate to elliptic, 5–12 by 3–6 cm, coriaceous, lower surface sparsely hairy, apex cuspidate, margin entire, base cuneate to obtuse. **Inflorescences** axillary, panicle, ca 15-flowered; peduncle up to 1.5 cm long, densely hairy; rachis 3.5–10 cm long, densely hairy; bracts deltoid to narrowly deltoid, 2–3 by 2 mm, densely hairy, apex acute, margin entire. **Flowers** zygomorphic, 1–1.5 cm in diam.; pedicels 4–5 mm long, densely hairy; bracteoles deltoid, ca 2 by 1 mm, densely hairy, apex acute, margin entire. **Calyx** dull-red, gamosepalous, campanulate, 5-lobed, densely hairy; tube 4–6 by 4–7 mm; lobes narrowly deltoid to broadly deltoid, 1 by 0.5–1 mm, apex acute, margin entire. **Corolla** pale-pink to white, free, papilionaceous,

petals 5, sparsely hairy outside; standard ovate to orbicular in outline, 2–2.3 by 1.7–2 cm, apex retuse, margin ciliolate at apex, base with bicallose; wings and keel similar, oblanceolate in outline, 1.8 by 1.1–1.2 cm, apex obtuse, margin ciliolate at upper part. **Stamens** 10, monadelphous; filaments 1.5–1.7 cm long, glabrous; anthers basifixed, 2-celled, ca 1 mm long, sparsely hairy. **Ovary** superior, ca 2 mm in diam., hairy, placentation marginal, 1-loculed; style 1, 1.3–1.4 mm long, sparsely hairy; stigma 1, punctiform, glabrous. **Fruit** a pod, pale-brown, flattened, elliptic-oblong to oblong, 3.5–6 by 2–2.5 cm, glabrous, apex acuminate, margin winged. **Seeds** reddish brown, flattened, reniform, ca 1 by 0.5 cm, glabrous. **Plate 4.H.**

**Thailand.**— Throughout Thailand.

**Distribution.**— Myanmar, Cambodia and Peninsular Malaysia.

**Ecology.**— In understory of floodplain vegetation. Flowering and fruiting from March to April.

**Vernacular.**— Kalam pho (กะล่ำพะ) (Phetchaburi); Khrua lain an (เครือไหล่น้ำ), Hang lai daeng (หางไหลแดง), Lai (ไหล), Lai nam (ไหล่น้ำ) (Northern); Pho-ta-ko-sa (โพทะโกส่า) (Karen-Mae Hong Son); Uat nam (อวดน้ำ) (Surat Thani).

**Specimens examined.**— *P. Pattarakulpisutti et al.* 216, 393, 652 (PSU).

**23. *Derris heptaphylla* Merr., Interpr. Rumph. Herb. Amboin. 273. 1917.**

Woody sprawling shrub, up to 1 m high; bark reddish brown, glabrous; branchlets 5–6 mm in diam., glabrous. **Leaves** imparipinnate, alternate; stipules absent; petiole 6.5–8 cm long, glabrous; rachis 6.5–7.5 cm long, glabrous; petiolules ca 1 cm long, glabrous; leaflets 5, ovate rarely elliptic, 8–14 by 4.8–8 cm, coriaceous, glabrous, apex retuse, margin entire, base obtuse. **Inflorescences** axillary, panicle, many flowered; peduncle 5–6 cm long, sparsely hairy; rachis up to 30 cm long, sparsely hairy; bracts absent. **Flowers** zygomorphic, 1–1.5 cm in diam.; pedicels 3–4 mm long, densely hairy. **Calyx** white, gamosepalous, campanulate, 5-lobed, densely

hairy; tube ca 5 by 4–8 mm; lobes broadly deltoid, ca 0.5 by 1 mm, indistinct when mature, apex acute, margin entire. **Corolla** greenish white, free, papilionaceous, petals 5, glabrous; standard orbicular to ovate in outline, 1.9–2 by 1.6–1.8 cm, apex retuse, margin entire, base without callus; wings oblanceolate in outline, 20–21 by 6–7 mm, apex obtuse, margin entire; keel falcate-lanceolate in outline, ca 20 by 8–9 mm, apex obtuse, margin entire. **Stamens** 10, diadelphous; filaments 1.6–2 cm long, glabrous; anthers basifixed, 2-celled, 1.5–2 mm long, glabrous. **Ovary** superior, ca 1 mm in diam., hairy, placentation marginal, 1-loculed; style 1, 7–9 mm long, hairy; stigma 1, punctiform, glabrous. **Fruits** a pod, pale-brown, flattened, strap-shaped, constricted between the seeds, 7–13 by 2.5–3 cm, coriaceous, glabrous, apex caudate, margin winged. **Seeds** green, flattened, falcate-lanceolate, 2–2.4 by 0.8 cm glabrous.

**Thailand.**— PENINSULAR: Trang.

**Distribution.**— Sri Lanka, India, China, Myanmar, Indochina, Malesia and Solomon Islands.

**Ecology.**— Along river bank. Flowering from June to August, fruiting in August.

**Vernacular.**—

**Specimens examined.**— *P. Pattarakulpisutti et al.* 399, 516 (PSU).

**24. *Derris scandens*** (Roxb.) Benth., J. Proc. Linn. Soc., Bot. 4(Suppl.): 103. 1860; Hook. f., Fl. Brit. India 2: 240. 1876; Ridl., Fl. Malay. Penin. 1: 595. 1922.

Woody climber; bark reddish brown, lenticellate, glabrous; branchlets 2–3 mm in diam., hairy. **Leaves** imparipinnate, alternate; stipule absent; petiole 2.6–4.5 cm long, sparsely hairy; rachis 2–3.5 cm long, sparsely hairy; petiolules ca 4 mm long, sparsely hairy; leaflets 5–9, elliptic to oblanceolate, 2.5–6 by 1.5–2.5 cm, subcoriaceous, lower surface hairy, apex retuse, margin entire, base cuneate to obtuse. **Inflorescences** axillary, raceme, many flowered; peduncle 2–2.8 cm long, hairy; rachis up to 30 cm long, hairy; bracts deltoid, ca 1.5 by 1 mm, densely hairy, apex

acuminate, margin entire. **Flowers** zygomorphic, 3–4 mm long; pedicels 5–7 mm long, hairy; bracteole elliptic, ca 1 by 0.5 mm, hairy, apex obtuse, margin entire. **Calyx** dull-red, gamosepalous, tubular, 5-lobed, sparsely hairy; tube ca 4 by 3 mm; lobes indistinct except the lowest lobe, ca 1 mm long. **Corolla** pinkish white, free, papilionaceous, peals 5, glabrous; standard obovate to orbicular in outline, ca 7 by 5 mm, apex obtuse, margin entire, base without callus; wings narrowly oblanceolate in outline, 7–8 by 1.5–2 mm, apex bluntly acute, margin ciliolate at lower part; keel obovate in outline, 7–8 by 3 mm, apex obtuse, margin ciliolate at apex. **Stamens** 10, monadelphous, filaments, 6–7 mm long, glabrous; anthers basifixed, 2-celled, ca 0.5 mm long, glabrous. **Ovary** superior, ca 1 mm in diam., densely hairy, placentation marginal, 1-loculed; style 1, ca 4 mm long, glabrous; stigma 1, capitate, ca 0.1 mm in diam., glabrous. **Fruit** and **Seeds** not seen.

**Thailand.**— PENINSULAR: Nakhon Si Thammarat, Trang, Songkhla, Pattani.

**Distribution.**— Sri Langa, China, Peninsular Malaysia and Australia.

**Ecology.**— Along river banks near the seas, estuaries or mangrove, also found on termite mounds in rice fields. Flowering from August to October, fruiting in October.

**Vernacular.**— (Khrua khao nang) (เครื่องเขานั่ง), (Thao ta pla) (เถาตาปลา) (Nakhon Ratchasima); (Thao wan priang) (เถาวัลย์เปรียง) (Central); Phan sanai (พานไสน) (Chumphon.)

**Specimen examined.**— *P. Pattarakulpisutti et al.* 380 (PSU).

**25. *Mucuna gigantea*** (Willd.) DC., Prodr. 2: 405. 1825; Ridl., Fl. Malay. Penin. 1: 577. 1922; Wilmot-Dear, Kew Bull. 47(2): 213. 1992.

Vine; stem ca 3 mm in diam., glabrous to sparsely hairy. **Leaves** trifoliate pinnate, alternate; stipules narrowly deltoid, ca 3 by 1 mm, glabrous, apex acute, margin entire; petiole 3.5–7 cm long, sparsely hairy; rachis 2–2.5 cm long,

sparsely hairy; petiolules ca 5 mm long, covered with irritant bristles; terminal leaflet elliptic, 6.5–9.5 by 2.5–4 cm, coriaceous, upper surface sparsely hairy, apex acuminate, margin entire, base obtuse; lateral leaflets ovate, 6–9 by 3–5 cm, upper surface sparsely hairy, apex acuminate, margin entire, base oblique. **Inflorescences** axillary, corymbose, 6–15-flowered; peduncle 6–14 cm long, sparsely hairy; bracts lanceolate, ca 2 by 1 mm, sparsely hairy, apex acuminate, margin entire. **Flowers** zygomorphic, 2–3 cm in diam.; pedicels 1.1–1.6 cm long, hairy; bracteoles caducous, lanceolate, 9–11 by 5 mm, densely covered with short hairs and irritant bristles, apex obtuse, margin entire. **Calyx** yellowish white, gamosepalous, campanulate, 5-lobed, unequal, densely covered with short hairs and irritant bristles; tube ca 2 by 1 cm; lowest lobe broadly deltoid, 2–3 by 3–4 mm, apex acute, margin entire; lateral lobes deltoid, ca 2 by 3 mm, apex acute, margin entire; upper lobe indistinct. **Corolla** white, free, papilionaceous, petals 5, glabrous; standard obovate in outline, 2–2.5 by 1.8–2 cm, apex obtuse, margin entire; wings falcate-lanceolate in outline, 3–3.5 by 1 cm, apex acute, margin ciliolate on lower part; keel falcate, ca 3 by 1.5 cm, apex acute, margin ciliolate. **Stamens** 10, diadelphous; filaments 2.5–3 cm long, glabrous; anthers dimorphic, 5–basifixed and 5–dorsifixed, 4-celled, ca 1 mm long, hairy at base. **Ovary** superior, ca 1 mm in diam., hairy, placentation marginal, 1-loculed; style 1, 2–2.5 cm long, hairy on lower part; stigma 1, punctiform, hairy at base. **Fruit** a pod, black, asymmetrically elliptic-oblong, 13.5–14 by 4–4.5 cm, sparsely covered with bristles, apex acuminate, each margin with a pair of distinct wings. **Seeds** brown, orbicular-reniform in outline, ca 2 cm in diam., ca. 5 mm thick, glabrous. **Plate 5.A.**

**Thailand.**— CENTRAL: Bangkok; PENNINSULAR: Phangna, Nakhon Si Thammarat, Trang, Satun, Songkhla.

**Distribution.**— India, Myanmar, Vietnam, Malaysia, Japan, Australia and Pacific islands.

**Ecology.**— Along river banks. Flowering and fruiting all year round.

**Vernacular.**— Krachiap (กระเจี๊ยบ), Ma Mui (หมามุ่ย), Ma Mui Chang (หมามุ่ยช้าง), Saba ling lai (สะบ้าลิงลาย) (Central).



**Specimens examined.**— *P. Pattarakulpisutti et al.* 400, 514 (PSU); *J.F. Maxwell* 85–631, 85–741 (PSU).

**26. *Sesbania javanica*** Miq., Fl. Ned. Ind. 1(1): 288. 1855; Backer & Bakh. f., Fl. Java (Spermatoph.) 1: 597. 1963.

Slender shrub, 1.5–2 m high; branchlets 1–2 mm in diam., sparsely hairy. **Leaves** paripinnate, alternate; stipules lanceolate, 2–3 by 0.5–1 mm, densely hairy, apex acuminate, margin entire; petiole 3–10 mm long, hairy; rachis 6–20 cm long, hairy; petiolules ca 1 mm long, densely hairy; leaflets 15–30 pairs, linear-oblong, 6–18 by 2–4 mm, chartaceous, lower surface hairy, apex mucronate, margin entire, base obtuse. **Inflorescences** axillary, raceme, 9–12-flowered; peduncle 1.5–2.4 cm long, hairy; rachis 3–4 cm long, hairy; bract absent. **Flowers** zygomorphic, 1–1.3 mm in diam.; pedicels ca 6 mm long, glabrous. **Calyx** green, gamosepalous, campanulate, 5-lobed, glabrous; tube ca 4 by 4 mm; broadly lobes deltoid, ca 1.5 by 2 mm, apex acute, margin entire. **Corolla** yellow, free, papilionaceous, petals 5, glabrous; standard orbicular to obovate in outline, 2–2.1 by 1.4–1.7 cm, glabrous, apex emarginate, margin entire, base with bicallose; wings oblong-lanceolate in outline, 2.1–2.2 by 4 mm, apex obtuse, margin entire; keel falcate in outline, ca 2.0–2.1 by 4 mm, apex obtuse, margin entire. **Stamens** 10, diadelphous; filaments 2.1–2.4 cm long, glabrous; anthers dorsifixed, 2-celled, ca 1 mm long, glabrous. **Ovary** superior, ca 1 mm in diam., glabrous, placentation marginal, 1-loculed; style 1, 5–7 mm long, glabrous; stigma 1, punctiform, glabrous. **Fruits** a pod, yellowish green, linear, terete, 1.3–2.0 by 0.3–0.4 cm, glabrous, apex acute, margin with ridge. **Seeds** green, terete, oblong, ca 3 by 2 mm, glabrous.

**Thailand.**— Throughout Thailand.

**Distribution.**— Sri Lanka, India, Bangladesh, China, Taiwan, Myanmar, Indochina, Malesia and Northern Australia

**Ecology.**— Weeds in rice fields and abandoned rice fields.

**Vernacular.**— Phak hong haeng (ผักฮ่องเฮง) (Northern); Si-pro-la (สี่ปรี  
หลา) (Karen-Mae Hong Son); Sano kin dok (โสนกินดอก), Sano hin (โสนหิน) (Central).

**Specimen examined.**— *P. Pattarakulpisutti et al.* 381 (PSU).

## HYDROPHYLLACEAE

**27. *Hydrolea zeylanica*** (L.) Vahl, Symb. Bot. 2: 46. 1791; C. B. Clarke in Fl. Brit. India (J. D. Hooker) 4: 133. 1883; Ridl., Fl. Malay. Penin. 2: 437. 1923; Backer & Bakh. f., Fl. Java (Spermatoph.) 2: 456. 1965; K. Larsen in Fl. Thailand. 7(2): 262. 2000.

Annual herb, up to 30 cm high; young branches sparsely hairy. **Leaves** simple, alternate; petiole up to 2 mm long, glabrous; blade lanceolate, 1–5 by 0.2–1.1 cm, membranous, glabrous, apex acute, margin entire, base attenuate. **Inflorescences** axillary and terminal, cymes; peduncle 4–7 mm long, covered with glandular hairs; bracts leafy, lanceolate, up to 1.1 by 0.2 mm, covered with glandular hairs, apex acute, margin entire. **Flowers** actinomorphic, ca 2 mm in diam.; pedicels 1–4 mm long, covered with glandular hairs; bracteoles leafy, lanceolate, up to 1.1 by 0.2 mm, covered with glandular hairs, apex acute, margin entire. **Calyx** light green, persistent, gamosepalous, campanulate, 5-lobed, covered with glandular hairs; lobes lanceolate, 4–6 by 1–1.5 mm, apex acute, margin entire; tube ca 2 by 2 mm. **Corolla** blue, connate with short tube, rotate, 5-lobed, glabrous; lobes ovate, 4–5 by 3 mm, glabrous, apex obtuse, margin entire, base obtuse. **Stamens** 5, free, epipetalous; filaments up to 2 mm long, glabrous; anthers versatile, 2-celled, 2 mm long, glabrous. **Ovary** superior, ca 2 mm in diam., hairy, placentation axile, 2-loculed; style 2, ca 2 mm long, hairy; stigma 1, capitate ca 0.1 mm in diam., glabrous. **Fruit** a capsule, ovoid, septicidal dehiscent, ca 3 by 2 mm, glabrous. **Seeds** small, ellipsoid, ca 0.25 by 0.25 mm, glabrous. **Plate 5.B.**

**Thailand.**— Throughout Thailand.

**Distribution.**— Tropical Asia to Australia.

**Ecology.**— In marshy areas and rice fields, disappear during dry period. Flowering and fruiting depend on inundation period.

**Vernacular.**— Po Phi (ปอผี) (Buri Ram).

**Specimen examined.**— *P. Pattarakulpisutti et al.* 176 (PSU).

## LAMIACEAE

**28. *Clerodendrum paniculatum*** L., Mant. Pl. 1: 90. 1767; Backer & Bakh. f., Fl. Java (Spermatoph.) 2: 611. 1965.

Shrub, up to 1.5 m high; young branches four-angled, hairy. **Leaves** simple, decussate; petiole up to 28 cm long, hairy; blade broadly ovate in outline, 3–25 by 2–30 cm, membranous, upper surface sparsely hairy, lower surface punctate, apex acuminate, margin deeply lobed, base cordate. **Inflorescences** terminal and axially near terminal, panicle; peduncle 2–4 cm long, hairy; rachis 4–60 cm long, hairy; bracts leaf-like, ovate in outline, 0.8–4 by 0.4–4.5 cm, upper surface sparsely hairy, lower surface punctate, apex acuminate, margin deeply lobed. **Flowers** slightly zygomorphic, 5–10 mm in diam.; pedicels 1–7 mm long, hairy; bracteoles narrowly deltoid to deltoid, 1–2 by 0.5 mm, hairy, apex acute, margin entire. **Calyx** red, connate with short tube, 5-lobed, hairy outside; tube very short; lobes oblanceolate to obovate, 4–5 by 1–2 mm, apex acute, margin entire. **Corolla** red, gamopetalous, salverform, 5-lobed, hairy outside; tube 4–7 by 1 mm; lobes oblanceolate to obovate, 3–4 by 2–3 mm, apex obtuse, margin entire. **Stamens** 4, free, epipetalous; filaments up to 3.5 cm long, glabrous; anthers dorsifixed, 2-celled, ca 2 mm long, glabrous. **Ovary** superior, ca 1 mm in diam., glabrous, placentation axile, 4-loculed; style 1, ca 3.5 cm long, glabrous; stigma bilobed, each lobe ca 0.1 mm long, glabrous. **Fruit** and **Seed** not seen. *Plate 5.C.*

**Thailand.**— Throughout Thailand.

**Distribution.**— India, Sri Lanka, Bangladesh, China, Taiwan, Indochina, Malesia and Australia.

**Ecology.**— Usually in open areas, roadsides and rice fields. Flowering and fruiting all year round.

**Vernacular.**— Chat fa (ฉัตรฟ้า), Sao sawan (สาวสวรรค์) (Nakhon Ratchasima); Nom sawan (นมสวรรค์) (Central, Peninsular); Phuang phi lueang (พวงผีเหลือง) (Loei); Hua ling (หัวลิง) (Saraburi); Ping-chon-wa (ปิ้งจก) (Khmer-surin); Pha nom sawan (พนมสวรรค์) (Peninsular); Phu muak (พุ่มผวก) (Bang kok).

**Specimen examined.**— *P. Pattarakulpisutti et al.* 412 (PSU).

**29. *Glossocarya linnaei*** Benth. & Hook. f., Gen. Pl. (Bentham & Hooker. f.) 2(2): 1158. 1876; C. B. Clarke in Fl. Brit. India (J. D. Hooker) 4: 598. 1885.

Scandent or woody climber; young branches four-angled, hairy. **Leaves** simple, decussate; petiole 0.5–2 mm long, hairy; blade broadly ovate, 3–10 by 3–8 cm, chartaceous, upper surface punctate, apex acute, margin entire, base truncate. **Inflorescences** terminal, panicle; peduncle 1.5–5 cm long, hairy; rachis 4–10 cm long, hairy; bracts leaf-like, broadly ovate, 5–35 by 2–20 cm, upper surface punctate, apex acute, margin entire. **Flowers** zygomorphic, 5–6 mm in diam., sessile; bracteoles filiform, 0.5–2 by 0.1 mm, hairy, apex acute, margin entire. **Calyx** pale green, gamosepalous, funnelform, 5-lobed, persistent, hairy outside; tube 2–2.5 by 1.5 mm; lobes deltoid, ca 1 by 0.5 mm, apex acute, margin entire. **Corolla** white, gamopetalous, salverform, 5-lobed, hairy outside; tube 4–5 by 1 mm; lobes obovate-lanceolate, 5 by 2–2.5 mm, apex obtuse, margin entire. **Stamens** 4, free, epipetalous, didynamous; filaments 6–7 mm long in shorter stamens and 1–1.2 cm long in longer ones, glabrous; anthers dorsifixed, 2-celled, ca 1 mm long, glabrous. **Ovary** superior, 1.5–2 mm in diam., hairy, placentation axile, 4-loculed; style 1, 1.5–1.7 mm long, glabrous; stigma 2, filiform, up to 1 mm long, glabrous. **Fruit** a capsule, septifragal dehiscent, black, ellipsoid, 2–6 by 2 mm, hairy. **Seeds** not seen. **Plate 5.D.**

**Thailand.**— PENINSULAR: Trang.

**Distribution.**— Sri Lanka and India.

**Ecology.**— In open area of seasonally flooded areas and along river. Flowering and fruiting from June to December.

**Vernacular.**—

**Specimens examined.**— *P. Pattarakulpisutti et al.* 348, 388 (PSU).

**30. *Premna annulata*** H. R. Fletcher, Bull. Misc. Inform. Kew 1938: 199. 1938.

Woody climber; flowering twigs 2–4 mm in diam., bluntly four-angled, glabrous to sparsely hairy. **Leaves** simple, opposite; petiole 2–5 mm long, hairy; blade narrowly elliptic, 4–8 by 1.8–3.5 cm, sub-coriaceous, glabrous, apex caudate-acuminate, margin entire to serrate on upper part, base obtuse. **Inflorescences** terminal, corymbose thyrse; peduncle up to 4 mm long, hairy; rachis 0.5–1.2 cm long, hairy; bracts narrowly deltoid to deltoid, 0.5–2 by 0.25–0.5 mm, hairy, apex acute, margin entire. **Flowers** zygomorphic, 2–3 mm in diam.; pedicels up to 4 mm long, hairy; bracteoles deltoid, ca 0.5 by 0.5 mm, hairy, apex acute, margin entire. **Calyx** greenish yellow with violet at apex, gamosepalous, campanulate, 4-lobed, persistent, glabrous; tube 1–1.5 by 2 mm; lobes indistinct, unequal; upper lobes deltoid, ca 0.5 by 1 mm, apex obtuse, margin entire; lower lobes indistinct. **Corolla** greenish yellow with yellow blotch inside, gamopetalous, bilabiate, 4-lobed, unequal, villose at throat; tube 2–3 by 2 mm; upper lobe quadrangular, 2–3 by 2 mm, apex truncate, margin entire; lateral lobes obovate, ca 1.5 by 1.5 mm, apex obtuse, margin entire; lower lobe orbicular, ca 2.5 by 2 mm, apex obtuse, margin entire. **Stamens** 4, free, epipetalous; filaments 2–2.5 mm long, glabrous; anthers basifixed, 2-celled, ca 0.5 mm long, glabrous. **Ovary** superior, ca 1 mm in diam., glabrous, placentation axile, 4-loculed; style 1, ca 3.5 mm long, glabrous; stigma bilobed, each lobe ca 0.25 mm long, glabrous. **Fruit** and **Seed** not seen. *Plate 5.E.*

**Thailand.**— PENINSULAR: Surat Thani, Phattalung, Trang, Songkhla.

**Distribution.**— Endemic to Thailand.

**Ecology.**— Woody climber on crown of trees or shrubs in rice fields. Flowering and fruiting all year round.

**Vernacular.** —

**Specimen examined.**— *P. Pattarakulpisutti et al.* 244–2 (PSU).

**31. *Vitex glabrata*** R. Br., Prodr. Fl. Nov. Holland. 512. 1810; C. B. Clarke in Fl. Brit. India (J. D. Hooker) 4: 588. 1885; Ridl., Fl. Malay. Penin. 2: 634. 1923; de Kok, Kew Bull.63: 22. 2008.

Shrub, 6–8 m high, dbh 10–15 cm; bark whitish grey; flowering twigs 3–5 mm in diam., bluntly four-angled, hairy when young. **Leaves** palmate compound, alternate; petiole 2–11 cm long, sparsely hairy; petiolules 2–10 mm long, sparsely hairy; leaflets 3–5, sub-equal except the lowest pair, oblanceolate-ovate to obovate, chartaceous, lower surface sparsely hairy on nerves, apex acuminate, margin entire, base obtuse, terminal leaflet 8–14 by 5–6 cm, the lowest pair, 3–5 by 1.5–3.2 cm. **Inflorescences** axillary, compound dichasial; peduncle 4.5–7 cm long, sparsely hairy; bract absent. **Flowers** zygomorphic, 1–1.2 mm in diam.; pedicels up to 4 mm long, sparsely hairy; bracteole absent. **Calyx** pinkish green, gamosepalous, funnelform, 5-lobed, persistent, sparsely hairy outside; tube 2 by 1.5–2 mm; lobes deltoid, ca 1 by 0.5 mm, apex acute, margin entire. **Corolla** white with pale violet on medial lobe, gamopetalous, bilabiate, 5-lobed, villous at throat and medial lobe; tube 4–5 by 2.5–3 mm; medial lobe pandurate, 6–7 by 4.5–5 mm, apex sub-acute, margin crenate on upper part; other lobes lanceolate-oblong, ca 2–3 by 2 mm, apex sub-acute to obtuse, margin entire. **Stamens** 4, free, epipetalous, didynamous; filaments 8–9 mm long for longer pair and ca 6 mm long for shorter pair, sparsely hairy on lower part; anthers dorsifixed, 2-celled, ca 0.75 mm long, glabrous. **Ovary** superior, ca 1.5 mm in diam., hairy at apex, placentation axile, 4-loculed; style 1, 8–9 mm long, glabrous; stigma bilobed, each lobe ca 0.5 mm long, glabrous. **Fruit** green, broadly ellipsoid to sub globose, 8–15 by 7–10 mm, glabrous. **Seed** not seen. **Plate 5.F.**

**Thailand.**— NORTH-EASTERN: Ubon Ratchathani, Loei; EASTERN: Surin; PENINSULAR: Trang.

**Distribution.**— India, Indochina, Malesia to Northern Australia.

**Ecology.**— In the edge of seasonally inundated areas. Flowering in April, fruiting from May to June.

**Vernacular.**— Khi hen (ขี้เหิน) (Ubon Ratchathani, Loei); Khai nao (ไข่เน่า) (General); Khom khwan (คมขวาน), Farang khok (ฝรั่งโคก) (Central); Plu (ปลู) (Khmer-surin).

**Specimens examined.**— *P. Pattarakulpisutti et al.* 260, 341, 368 (PSU).

## LECYTHIDACEAE

**32. *Barringtonia acutangula*** (L.) Gaertn., *Fruct. Sem. Pl.* 2: 97. 1791; C. B. Clarke in *Fl. Brit. Ind.* (J. D. Hooker) 2: 508. 1879; Chantar., *Kew Bull.* 50(4): 680. 1995.

Tree, up to 20 m high, dbh 25–30 cm; bark brownish grey; branchlets 2–4 mm in diam., glabrous. **Leaves** simple, spiral, crowded on branch tips; petiole up to 1.3 cm long, glabrous; blade oblanceolate to obovate, 5.5–18 by 3–7.5 cm, chartaceous, glabrous, apex obtuse or acute, margin serrate, base cuneate. **Inflorescences** terminal, raceme, pendulous, ca 30–90-flowered; peduncle 2.5–3.5 cm long, sparsely hairy; rachis 20–80 cm long, sparsely hairy; bract absent. **Flowers** actinomorphic, ca 5 mm in diam.; pedicels 1–1.5 mm long, sparsely hairy; bracteole absent. **Hypanthium** funnellform, ca 1 by 2 mm, sparsely hairy. **Calyx** green, persistent, connate with short tube, 4-lobed, oblong, ca 3 by 2 mm, sparsely hairy, apex obtuse, margin ciliolate. **Corolla** pale pink to red, free, caducous, petals 4; oblong, 5–8 by 3–4 mm, sparsely hairy, apex obtuse, margin ciliolate, base adnate to staminal tube for 1 mm. **Stamens** numerous, free; filaments 1.5–2 mm long, glabrous, connate at base into staminal tube, ca 1 mm long; anthers basifixed, 2-celled, ca 0.25 mm long, glabrous. **Ovary** inferior, ca 1 mm in diam., placentation axile, 2-loculed; style 1, 1.6–1.8 cm long, glabrous; stigma 1, punctiform. **Fruit** a berry, yellowish green, depressed-subglobose, 1.5–2.5 by 2.2–3 cm, lobed, glabrous. **Seeds** brown, sub-globose, 1.3–2.3 by 2–2.8 cm, glabrous. **Plate 5.G.**

**Thailand.**— Throughout Thailand.

**Distribution.**— Afghanistan, Pakistan, India, Sri Lanka, Indochina, Malesia, Northern Australia and the Pacific island.

**Ecology.**— Very common along streams, marshy areas and seasonally inundated swamp forests. Flowering from April to August, fruiting from June to October.

**Vernacular.**— Kradon thung (กระโดนทุ่ง), Kradon nam (กระโดนน้ำ) (Nong Khai); Kradon soi (กระโดนสร้อย) (Phitsanulok); Chik na (จิกนา), Chik nam (จิกน้ำ) (Central); Chik (จิก) (Bangkok); Tong (ตอง) (Northern); Pui sai (ปุยสาย) (Northern); Lam phai (ลำไผ่) (Uttaradit).

**Specimens examined.**— *P. Pattarakulpisutti et al.* 196, 239, 276, 369, 379, 415 (PSU); *P. Siriragsa* 691(PSU); *J.F. Maxwell* 85–632, 86–870 (PSU).

**33. *Barringtonia racemosa* (L.) Spreng., Syst. Veg. 3: 127. 1826; Chantar., Kew Bull. 50(4): 689. 1995.— *B. racemosa* Blume., C. B. Clarke in Fl. Brit. Ind. (J. D. Hooker) 2 : 507. 1879.— *B. racemosa* Roxb. Ridl., Fl. Malay. Penin. 1: 757. 1922.— *B. racemosa* (L.) ex DC., Backer & Bakh. f., Fl. Java (spermatoph.) 1: 353. 1963.**

Trees, 8–10 m high, dbh 25–30 cm; bark brownish grey; branchlets 5–7 mm in diam., glabrous. **Leaves** simple, spiral, crowded on branch tips; petiole up to 4–10 cm long, glabrous; blade oblanceolate, 20.5–30 by 7–12 cm, chartaceous, glabrous, apex acuminate, margin serrate-crenulate, base attenuate. **Inflorescences** terminal, spike, pendulous, ca 40–50-flowered; peduncle 45–91 cm long, glabrous; rachis 20–80 cm long, glabrous; bract absent. **Flowers** actinomorphic, ca 4 cm in diam.; pedicels 5–7 mm long, glabrous; bracteole absent. **Hypanthium** funnellform, 3–4 by 7 mm, glabrous. **Calyx** green, persistent, close in bud and splitting in to 2–4 unequal segments, oblong to ovate 1–1.2 by 5–8, glabrous, apex obtuse to acute, margin entire. **Corolla** pale pink, free, caducous, petals 4–5; oblong, 2.6–2.8 by 1–1.4 cm, glabrous, apex obtuse, margin entire, base adnate to staminal tube for 2 mm. **Stamens** numerous; filaments 3.6–4.5 cm long, glabrous, connate at base into staminal tube, ca.



1 mm long; anthers basifixed, 2-celled, ca 1 mm long, glabrous. **Ovary** inferior, 2–3 mm in diam., placentation axile, 4-loculed; style 1, 5–5.2 cm long, glabrous; stigma 1, capitate, ca 0.5 mm in diam., glabrous. **Fruit** a berry, dull red, quadrangular, 4.5–5 by 2.2–3.5 cm, glabrous. **Seeds** not seen. **Plate 5.H.**

**Thailand.**— CENRAL: Bangkok, Samut Prakan; PENNINSULAR: Surat Thani, Nakhon Si Thammarat, Trang.

**Distribution.**— Mozambique, Madagascar, India, Sri Lanka, Laos, Japan, Malesia and Northern Australia.

**Ecology.**— Open thickets along rivers and marshy areas. Flowering from May to June, fruiting from May to July.

**Vernacular.**— Chik ban (จิกบ้าน), Chik suan (จิกสวน) (Bangkok); Pu-ta (ปูตะ) (Malay-Narathiwat).

**Specimen examined.**— *P. Pattarakulpisutti et al.* 361 (PSU).

#### LENTIBURACEAE

**34. *Utricularia bifida*** L., Sp. Pl. 1: 18. 1753; C. B. Clarke in Fl. Brit. India (J. D. Hooker) 4: 332. 1884; Ridl., Fl. Malay. Penin. 2: 492. 1923; Backer & Bakh. f., Fl. Java (Spermatoph.) 2: 518. 1965; P. Taylor in Fl. Males., Ser. 1, Spermat. 8(2): 281, fig. 4. 1977; J. F. Maxwell, Songklanakar J. Sci. Technol. 7 (4): 413. 1985.

Carnivorous herb, 8.5–11 cm high; stem erect, glabrous; scales lanceolate to narrowly deltoid, 1.5–2 by 0.5–1 mm, glabrous, apex acute, margin entire. **Leaves** not seen. **Inflorescences** terminal, raceme, usually 2–4-flowered; peduncle 8–12 mm long, glabrous; rachis 2–2.5 cm long; bracts lanceolate to narrowly deltoid, 1.5–2 by 0.5–1 mm, glabrous, apex acute, margin entire. **Flowers** zygomorphic, ca 5 mm in diam.; pedicels 1–2 mm long, glabrous; bracteoles subulate, 0.5–1 by 0.25 mm, glabrous, apex acute, margin entire. **Calyx** dark red, connate with short tube, bilabiate, 2-lobed, glabrous; tube indistinct; upper lobe broadly ovate, 2–2.5 by 2 mm, apex sub-acute, margin entire; lower lobe orbicular-ovate, ca 2 by 2

mm, apex obtuse, margin entire. **Corolla** yellow with red vertical lines on upper lip, gamopetalous, bilabiate, 2-lobed, glabrous; tube 2–3 by 1 mm; upper lip oblanceolate-elliptic, 4 by 1.75–2 mm, apex sub-acute, margin entire; lower lip reniform in outline, ca 3 by 4 mm, apex emarginate, margin entire; palate ca 1 by 1 mm; spur 4–5 by 1 mm, apex acute, curved. **Stamens** 2, free; filaments ca 2 mm long, winged, glabrous; anthers dorsifixed, 2-celled, ca 0.5 mm long, glabrous. **Ovary** superior, ca 1 mm in diam., glabrous, placentation free basal, 1-loculed; style 1, ca 1 mm long, glabrous; stigma unequally 2-lobed, each lobe ca 0.25 mm in diam., glabrous. **Fruit** a capsule, ovoid, dorsi-ventrally compressed, ca 2.5 by 3 mm, glabrous. **Seeds** ovoid to ellipsoid, ca 0.5 by 0.25 mm, surface reticulated. **Plate 6.A.**

**Thailand.**— Throughout Thailand.

**Distribution.**— India to Japan, Indochina, Malesia and Northern Australia.

**Ecology.**— In marshy areas and rice fields, disappear during dry period. Flowering and fruiting all year round but depend on inundation period.

**Vernacular.**— Ya si thong (หญ้าสีทอง) (Loei); Lueang pit sa mon (เหืองพิสมร), Soi suwanna (สร้อยสุวรรณา) (Bangkok); Sarai dok lueang (สาหร่ายดอกเหือง) (Central).

**Specimen examined.**— *P. Pattarakulpisutti et al.* 376 (PSU).

**35. *Utricularia caerulea*** L., Sp. Pl. 1: 18. 1753; P. Taylor in Fl. Males., Ser. 1, Spermat. 8(2): 287, fig. 12. 1977; J. F. Maxwell, Songklanakarin J. Sci. Technol. 7 (4): 414. 1985.— *U. nivea* Vahl, Enum. Pl. (Vahl) 1. 203. 1804; Backer & Bakh. f., Fl. Java (Spermatoph.) 2: 518. 1965.— *U. albina* Ridl., Fl. Malay. Penin. 2. 493. 1923.

Carnivorous herb, 2.5–5.5 cm high; stem erect, glabrous; scales peltate, lanceolate, 0.5–1.5 by 0.25 mm, glabrous, apex acute, margin entire. **Leaves** not seen. **Inflorescences** terminal, raceme, 2–3-flowered; peduncle up to 1.4 cm long, glabrous; rachis up to 1.1 cm long; bracts peltate, lanceolate, 0.5–1.5 by 0.25 mm, glabrous,

apex acute, margin entire. **Flowers** zygomorphic, 1–2 mm in diam.; pedicels 0.5–1 mm long, glabrous; bracteoles obovate-lanceolate, ca 1 by 0.5 mm, glabrous, apex acute, margin serrulate. **Calyx** pinkish green, connate with short tube, bilabiate, 2-lobed, papillose outside; tube indistinct; lobes sub-equal, orbicular-ovate, 0.5–1.5 by 0.5–1.5 mm, apex obtuse to sub-acute, margin entire. **Corolla** white with two yellow blotches on palate, gamopetalous, bilabiate, 2-lobed, glabrous; tube 0.5–0.7 by 0.25 mm; upper lip oblong, 1–2 by 0.5–1 mm, apex truncate to emarginate, margin entire; lower lip orbicular, 1–2 by 1–2 mm, apex shallowly 3-lobed, margin inrolled; palate indistinct; spur 1–3 by 0.5–1 mm, apex obtuse, curved. **Stamens** 2, free; filaments 0.75–1 mm long, winged, glabrous; anthers dorsifixed, 2-celled, ca 0.5 mm long, glabrous. **Ovary** superior, 0.25–0.75 mm in diam., glabrous, placentation free central, 1-loculed; style 1, 0.25–0.5 mm long, glabrous; stigma unequally 2-lobed, each lobe ca 0.1 mm in diam., glabrous. **Fruit** a capsule, sub-globose, ca 2 by 2 mm, glabrous. **Seeds** not seen. **Plate 6.B.**

**Thailand.**— Throughout Thailand.

**Distribution.**— India to China and Japan, Indochina, Malesia and Northern Australia.

**Ecology.**— In marshy areas and rice fields, disappear during dry period. Flowering and fruiting all year round but depend on inundation period.

**Vernacular.**— Ya kheam (หญ้าน้ำซึม) (Loei).

**Specimens examined.**— *P. Pattarakulpisutti et al.* 292, 373 (PSU).

## LORANTHACEAE

**36. *Macrosolen cochinchinensis*** (Lour.) Tiegh., Bull. Soc. Bot. France 41: 122. 1894; Backer & Bakh. f., Fl. Java (Spermatoph.) 2: 69. 1965; Barlow in Fl. Males., Ser. 1, Spermat. 13: 366, fig. 35. 1997.

Parasitic plant; flowering twigs 3–7 mm in diam., glabrous. **Leaves** simple, opposite; petiole 5–11 mm long, glabrous; blade narrowly ovate to ovate, 6–

12 by 2.5–5.5 cm, coriaceous, glabrous, apex acute, margin entire, base cuneate to obtuse. **Inflorescences** at nodes, spike, 6–10-flowered; peduncle 4–8 mm long, glabrous; rachis 5–30 mm long, glabrous. **Flowers** actinomorphic, 7–8 mm in diam., sessile; bracts deltoid, ca 1 by 1 mm, sparsely hairy outside, apex obtuse to acute, margin entire. **Calyx** brown, a membranous limb at the apex of the ovary, ca 0.5 mm long. **Corolla** brown, gamopetalous, funnellform, 6-lobed, glabrous; tube 5–7 by 2–5 mm; lobes oblanceolate-linear, 6–7 by 1.5 mm, apex obtuse, margin entire. **Stamens** 6, free, epipetalous; filaments ca 5 mm long, glabrous; anthers basifixed, 2-celled, ca 1 mm long, glabrous. **Ovary** inferior, 2–3 mm in diam., glabrous, placentation axile, 6-loculed; style 1, 1.1–1.2 cm long, glabrous; stigma 1 capitate, ca 1 mm in diam., glabrous. **Fruit** berry-like, black, broadly ellipsoid to sub-globose; 3–5 by 2–4 mm, glabrous. **Seeds** not seen.

**Thailand.**— Throughout Thailand.

**Distribution.**— From Himalayan eastwards to Southern China and Indochina and Malesia.

**Ecology.**— Very common parasitic species in open forests. Flowering and Fruiting from August to January.

**Vernacular.**— Prathat nuan (ประพัตถนวล) (Peninsular).

**Specimens examined.**— *P. Pattarakulpisutti et al.* 194, 417 (PSU).

## LYTHRACEAE

**37. *Lagerstroemia floribunda*** Jack in Malay. Misc. 1: 38. 1820; C. B. Clarke in Hook. f., Fl. Brit. India (J. D. Hooker) 2: 577. 1879; Ridl., Fl. Malay Penins. 1: 823. 1922; B. Everett & Whitmore in Tree Fl. Mal. 2: 279. 1973.

Small tree, up to 10 m high, dbh up to 35 cm; bark dark brown, vertically cracked; flowering twigs 5–10 mm in diam., young branch covered with stellate hairs. **Leaves** simple, opposite; stipules caducous, ovate-lanceolate, 6–7 by 3–

4 mm, outside covered with stellate hairs, apex acute, margin entire; petiole 3–5 mm long, glabrous; blade narrowly elliptic or narrowly oblong, 8.5–18.5 by 3–7.5 cm, coriaceous, glabrous, apex acute, margin entire, base obtuse. **Inflorescences** terminal and axillary, panicle, many flowered; peduncle up to 3 cm long, covered with stellate hairs; rachis 15–30 cm long, covered with stellate hairs; bract not seen. **Flowers** actinomorphic, 2.5–3 cm in diam.; pedicels up to 3 mm long, covered with stellate hairs; bracteole not seen. **Hypanthium** campanulate, 8–10 by 6–10 mm, covered with stellate hairs, with 10–12 ridges. **Calyx** reddish brown, persistent, gamosepalous, 6-lobed, deltoid, 5–7 by 2–3 mm, densely hairy, apex caudate, margin entire. **Corolla** purple and become white when old, free, petals 6–8, obovate in outline, 1.3–1.8 by 0.8–1.5 cm, glabrous, wrinkled, apex obtuse, margin undulate, base clawed. **Stamens** numerous; filaments 1.3–1.6 cm long, glabrous; anthers dorsifixed, 2-celled, ca 1 mm long, glabrous. **Ovary** superior, 3–4 mm in diam., densely hairy, placentation axile, 6-loculed; style 1, ca 8 mm long, glabrous; stigma 1, capitate, ca 0.5 mm in diam., glabrous. **Fruit** a capsul, loculicidal dehiscent, brownish-grey, oblong, 13–15 by 8–15 cm, densely hairy. **Seeds** light brown, lanceolate to elliptic, laterally compressed, ca 8 by 3 mm, glabrous. **Plate 6.C.**

**Thailand.**— PENINSULAR: Trang, Satun.

**Distribution.**— India, China, Myanmar and Peninsular Malaysia.

**Ecology.**— In seasonally fresh water swamp forests, roadsides, old rice fields, marshy areas and termite mounds. Flowering from June to May, fruiting from March to November.

**Vernacular.**— Kra baek (กระแบก) (Songkhla); Tra beak pri (ตราแบกปรี) (Khmer); Ta baek khai (ตะแบกไข่) (Ratchaburi, Trat); Ta beak na (ตะแบกนา) (Central, Nakhon Ratchasima); Ban-go-ta-ma-ko (บางอตะมะกอ) (Malay-Yala, Pattani); Ba-ngo-ya-mu (บางอยามู) (Malay-Narathiwat); Pueai dong (เปื้อยดอง), Pueai na (เปื้อยนา) (Lampang); Pueai hang khang (เปื้อยหางค่าง) (Phrae).

**Specimens examined.**— *P. Pattarakulpisutti et al.* 416, 503 (PSU); *G. Congdon* 613 (PSU).

**38. *Lagerstroemia speciosa*** Pers. Syn. Pl. (Persoon) 2(1): 72. 1806; B. Everett & Whitmore in Tree Fl. Mal. 2: 280. 1973.

Tree, up to 25 m high, dbh up to 35 cm; bark light grey, smooth, scaly; flowering twigs 3–5 mm in diam., glabrous; **Leaves** simple, opposite; stipules deltoid, ca 1 by 1 mm, glabrous, apex acute, margin entire; petiole 4–10 mm long, glabrous; blade elliptic-oblong, 8.5–17 by 3–8.5 cm, coriaceous, glabrous, apex acuminate, margin entire, base obtuse. **Inflorescences** terminal and axillary, panicle, up to 30-flowered; peduncle 2.4–4 cm long, sparsely hairy; rachis 13.5–24.5 cm long, sparsely hairy; bract not seen. **Flowers** actinomorphic, 4–5.5 cm in diam.; pedicels 5–8 mm long, densely covered with short hairs; bracteoles deltoid, ca 1 by 1 mm, densely covered with short hairs, apex acute, margin entire. **Hypanthium** campanulate, 6–7 by 8–10 mm, densely covered with short hairs, with 12–14 ridges. **Calyx** purplish-green, persistent, gamosepalous, 6–7 lobed, deltoid, 6–7 by 5–6 mm, dense short hairs, apex acute, margin entire. **Corolla** purple, free, sepals 6–7, obovate in outline, 2.2–3 by 1.7–2 cm, glabrous, wrinkled, apex obtuse, margin undulate, base clawed. **Stamens** numerous; filaments up to 3 cm long, glabrous; anthers dorsifixed, 2-celled, 1–1.5 mm long, glabrous. **Ovary** superior, 4–6 mm in diam., densely hairy, placentation axile, 6-loculed; style 1, 2–2.5 cm long, glabrous; stigma 1, capitate, 0.5–0.75 mm in diam. glabrous. **Fruit** a capsule, loculicidal dehiscent, light brown, broadly elliptic to sub-globose, 2.5 by 2–2.5 cm, glabrous. **Seeds** light brown, falcate, laterally compressed, ca 2 by 0.7 cm, glabrous. **Plate 6.D.**

**Thailand.**— PENINSULAR: Trang.

**Distribution.**— Southern China, Indochina and Malesia.

**Ecology.**— In seasonally fresh water swamp forests, roadsides, old rice fields and marshy areas. Flowering and fruiting from March to October.

**Vernacular.**— Chuang-mu (ฉ้างมู) (Karen-Kanchanaburi); Chong-pra-na (ฉ่องพนา) (Karen-Kanchanaburi); Ta beak dam (ตะแบกดำ) (Bangkok); Ba-ngo-ba-sa (บางอปะซา) (Malay-Yala, Narathiwat); Ba-ye (บายะ), Ba-e (Malay-Pattani); Inthanin (อินทนิล), Inthanin nam (อินทนิลน้ำ) (Central, Peninsular).

**Specimens examined.**— *P. Pattarakulpisutti et al.* 246, 281, 515 (PSU).

## MALVACEAE

**39. *Melochia corchorifolia*** L., Sp. Pl. 2: 675. 1753; Mast. in Fl. Brit. India (J. D. Hooker) 1: 374. 1874; Ridl., Fl. Malay Penins. 1: 284. 1922; Phengkklai in Fl. Thailand. 7(3): 592, fig. 86a-c. 2001.

Annual herb, 40–55 cm high, young part sparsely hairy. **Leaves** simple, alternate; stipules narrowly lanceolate, 3–4; by 1 mm, glabrous, apex acute, margin ciliate; petiole 0.5–2.5 mm long, densely covered with stellate hairs; blade deltoid to narrowly lanceolate, 1.5–4 by 0.7–7 cm, chartaceous, hairy on nerves, apex acute, margin serrate, base truncate. **Inflorescences** densely clustered on terminal and axillary, 3–7-flowered; bracts narrowly lanceolate, 6–8 by 1 mm, sparsely hairy outside, apex acute, margin entire. **Flowers** actinomorphic, ca 1 cm in diam.; pedicels up to 2 mm long, densely hairy; bracteoles awl-shaped, 4–6 by 0.5 mm, sparsely hairy outside, apex acute, margin entire. **Calyx** green, gamosepalous, campanulate, 5-lobed, sparsely hairy outside; tube 3–4 by 3–4 mm; lobes deltoid, ca 1 by 1 mm, apex cuspidate, margin entire. **Corolla** pale pink and yellow at base, free, sepals 5, obovate-lanceolate, 6–7 by 2–2.5 mm, glabrous, apex obtuse, margin entire. **Stamens** 5, connate at base; filaments ca 2 mm long, glabrous; anthers dorsifixed, 2-celled, ca 1 mm long, glabrous. **Ovary** superior, ca 1 mm in diam., densely hairy, placentation axile, 3-loculed; styles 5, 1.5–2 cm long, glabrous; stigma 5, punctiform, glabrous. **Fruit** and **Seed** not seen. **Plate 6.E.**

**Thailand.**— NORTHERN: Chiang Mai, Uttaradit; SOUTH-WESTERN: Kanchanaburi; CENTRAL: Chai Nat, Ang Thong, Phra Nakhon Si

Ayutthaya, Bangkok; SOUTH-EASTERN: Chachoengsao; PENINSULAR: Surat Thani, Trang, Satun.

**Distribution.**— India, Southern China, Vietnam, Taiwan, Japan, Peninsular Malaysia, Indonesia, Philippines, Australia and Polynesia.

**Ecology.**— Usually in open areas, rice fields and roadsides. Flowering from April to September, fruiting from August to October.

**Vernacular.**— Khang pak put (ขางปากพูด) (Northern); Sa-aeng bai mon (สะอแงไบมน), Seng lek (เส็งเล็ก) (Central).

**Specimen examined.**— *P. Pattarakulpisutti et al.* 275 (PSU).

**40. *Microcos tomentosa*** Sm., in Rees, Cycl. 23. 1813; Phengkhai in Fl. Thailand. 6(1): 37, fig. 23a-b. 1993.— *Grewia paniculata* Roxb. ex DC., Prodr. (DC.) 1: 510. 1824; Mast. In Fl. Brit. India (J. D. Hooker) 1: 393. 1874; Ridl., Fl. Malay Penins. 1: 300. 1922.

Shrub to small tree, up to 6 m high, dbh up to 20 cm; bark brown, smooth; flowering twigs 4–5 mm in diam., young branches densely covered with stellate hairs. **Leaves** simple, alternate; stipules narrowly oblong to linear oblong, 2–5 by 1 mm, densely covered with stellate hairs, apex acute, margin entire; petiole 5–7 mm long, densely covered with stellate hairs; blade obovate, 7.5–14 by 3.5–9 cm, chartaceous, sparsely covered with stellate hairs, apex acuminate, margin serrulate on upper part, base truncate. **Inflorescences** terminal and axillary, panicle, many flowered; peduncle 8–10 mm long, densely covered stellate hairs; rachis 3–5.5 cm long, densely covered with stellate hairs; bracts awl-shaped, 4–6 by 1 mm, densely covered with stellate hairs, apex acute, margin entire. **Flowers** actinomorphic, 1–1.2 cm in diam.; pedicels 5–7 mm long, densely covered with stellate hairs; bracteoles enclose 3 flowering buds, splitting in to 9 unequal segments, elliptic to narrowly elliptic, 5–6 by 2–3 mm, densely covered with stellate hairs, apex acuminate, margin entire. **Calyx** light green to brown, free, sepal 5, oblanceolate, 5–6 by 2 mm, densely covered with stellate hairs, apex sub-acuminate, margin entire. **Corolla** light green to



brown, free, petal 5, oblong, ca 2 by 1 mm, sparsely hairy, apex emarginate, margin entire. *Stamens* numerous; filaments 2–4 mm long, glabrous; anthers dorsifixed, 2-celled, ca 0.25 mm long, glabrous. *Ovary* superior, ca 1.5 mm in diam., densely hairy, placentation axile, 3-loculed; style ca 2 mm long, sparsely hairy; stigma 1, punctiform, glabrous. *Fruit* and *Seed* not seen. **Plate 6.F.**

**Thailand.**— Throughout Thailand.

**Distribution.**— India, Southern China, Indochina, Peninsular Malaysia, Indonesia and Philippines.

**Ecology.**— In edge of semi-evergreen forests, roadsides and termite mounds. Flowering from May to August, fruiting from June to November.

**Vernacular.**— Kapok kapu (กะปุกกะปู้), Sak kabuea dong (สากกะเบือคอง), Sak kabuea lawa (สากกะเบือลาว้า), Mak hom (หมากหอม), Lai (ลาย), Pla (ปลา), Khom (ค่อม) (Northern); Khom som (ค่อมส้ม), Kom som (ก้อมส้ม) (North-eastern); Phlong som (พลองส้ม), Khom kliang (ค่อมเกลี้ยง) (Eastern); Malai (มลาย) (South-eastern); Phlap phla (ปลับปลา), Khi thao (ขี้เต้า) (Central); Chue mue kae (จือมือแก) (Malay/Peninsular); Namlai Khwai (น้ำลายควาย), Phla khao (ปลาขาว), Phla lai (ปลาลาย) (Peninsular).

**Specimen examined.**— *P. Pattarakulpisutti et al.* 244 (PSU).

**41. *Pentapetes phoenicea*** L., Sp. Pl. 2: 698. 1753; Mast. in Fl. Brit. India (J. D. Hooker) 1: 371. 1874; Ridl., Fl. Malay Penins. 1: 284. 1922; Phengklai in Fl. Thailand. 7(3): 595, fig. 88a-b. 2001.

Annual aquatic herb, up to 1 m high, glabrous. *Leaves* simple, alternate; stipules narrowly lanceolate, 7–10 by 1–2 mm, glabrous, apex acuminate, margin ciliate; petiole 4–12 mm long, hairy; blade narrowly lanceolate, 6–10 by 0.5–1 cm, membranous, hairy on nerves, apex acuminate, margin serrate, base truncate. *Inflorescences* axillary, scorpioid, 2–3-flowered; peduncle 8–15 mm long, sparsely hairy; bracts narrowly lanceolate, 5–6 by 1–2, glabrous, apex acuminate, margin

ciliate. **Flowers** actinomorphic, ca 3 cm in diam.; pedicels 1–2 mm long, sparsely hairy; bracteoles lanceolate, 4–8 by 2–3 mm, hairy outside, apex acuminate, margin entire. **Calyx** light green, persistent, connate with short tube, 5-lobed, sparsely hairy outside; tube very short; lobes ovate-lanceolate, 15–17 by 4–6 mm, apex acuminate, margin entire. **Corolla** reddish orange, sepals 5, free, obdeltoid, 1.6–1.8 by 2.1–2.2 cm, glabrous, apex truncate, margin crenulate at upper part. **Stamens** 15, connate at base, arranged in 5 groups, each group alternate with staminode; filaments 4–5 mm long, glabrous; anthers basifixed, 2-celled, ca 4 mm long, glabrous. **Ovary** superior, ca 3 mm in diam., densely hairy, placentation axile, 5-loculed; style 1, ca 1.5 cm long, twisted, glabrous; stigma 5, filiform, ca 2 mm long, glabrous. **Fruit** and **Seed** not seen. **Plate 6.G.**

**Thailand.**— Throughout Thailand.

**Distribution.**— India, China and Peninsular Malaysia.

**Ecology.**— On seasonally inundated areas and rice fields, disappear during dry period. Flowering and fruiting depend on flood period.

**Vernacular.**— Po Seng (ปอเส็ง), Seng (เส็ง) (Central).

**Specimen examined.**— *P. Pattarakulpisutti et al.* 167 (PSU).

**42. *Sida rhombifolia* L., Sp. Pl. 2: 684. 1753; Mast. in Fl. Brit. India (J. D. Hooker) 1: 323. 1874; Ridl., Fl. Malay Penins. 1: 253. 1922.**

Undershrub, 9–60 cm high; flowering twigs 1–2 mm in diam., covered with stellate hairs when young. **Leaves** simple, alternate; stipules filiform, 3–5 mm long, covered with stellate hairs; petiole 2–2.5 mm long, covered with stellate hairs; blade obovate, 5–20 by 5–17 mm, sub-coriaceous, upper surface sparsely covered with stellate hairs, lower surface densely covered with stellate hairs, apex obcordate to truncate, margin serrulate, base cuneate. **Flowers** solitary, actinomorphic, 8–11 mm in diam.; peduncle 7–16 mm long, covered with stellate hairs; bract absent. **Calyx** green, gamosepalous, campanulate, 5-lobed, covered with stellate hairs outside; tube 3–4 by

7–8 mm; lobes deltoid, 4–5 by 2 mm, apex acute, margin entire. **Corolla** yellow, fused only at base and with stamina tube, 5-lobed, glabrous; lobes obliquely obovate, 6–9 by 10–12 mm, apex emarginate, margin entire. **Stamens** numerous; filaments connate at base into stamina tube, 3–4 mm long, glabrous; free part 1.75–2 mm long, glabrous; anthers dorsifixed, 1-celled, ca 0.5 mm long, glabrous. **Ovary** superior ca 2 mm in diam., glabrous, placentation axile, 8–10-loculed; styles 8–10, connate at base into tube, ca 2 mm long glabrous; free part ca 4 mm long, glabrous; stigma 8–10, capitate, ca 0.25 mm in diam., glabrous. **Fruit** and **Seed** not seen. **Plate 6.H.**

**Thailand.**— Throughout Thailand.

**Distribution.**— Pantropics and subtropics.

**Ecology.**— Common in open areas, rice fields and waysides. Flowering and fruiting from August to October.

**Vernacular.**— Khat mon (ขั้ดมอน, คั้ดมอน) (Central); Yak hat (หญั้ขั้ด) (Chiang Mai); Yung pat mae mai (ยุงปั้ดแม่ม่้ย) (Bangkok).

**Specimen examined.**— *P. Pattarakulpisutti et al.* 462–2 (PSU).

**43. *Urena lobata* L., Sp. Pl. 2: 692. 1753; Mast. in Fl. Brit. India (J. D. Hooker) 1: 329. 1874; Ridl., Fl. Malay Penins. 1: 256. 1922.**

Undershrub, up to 1 m high; flowering twigs 1.5–2 mm in diam., covered with stellate hairs when young. **Leaves** simple, alternate; stipules subulate, ca 1 by 0.25 mm, sparsely hairy; petiole 3–12 mm long, covered with stellate hairs; blade cordate, 3–5-lobed, 8–45 by 7–30 mm, chartaceous, upper surface sparsely covered with stellate hairs, lower surface densely covered with stellate hairs, apex acute, margin serrulate, base cordate to truncate. **Flowers** solitary, actinomorphic, 12–15 mm in diam.; peduncle ca 2 mm long, covered with stellate hairs; bracts epicalyx, connate at base, campanulate, 5-lobed, sparsely hairy outside; tube ca 2 by 3 mm; lobes narrowly oblong, 3–4 by 1, apex acute, margin entire. **Calyx** green, gamosepalous, campanulate, 5-lobed, sparsely hairy outside; tube ca 1 by 3 mm; lobes

elliptic-oblong, 4–5 by 2–2.5 mm, apex acuminate, margin ciliolate. **Corolla** pink, fused at base with stamina tube, 5-lobed, glabrous; lobes obliquely ovate, 12–14 by 7–8 mm, apex obtuse, margin entire. **Stamens** numerous; filaments connate at base into staminal tube, 7–8 mm long, glabrous; anthers dorsifixed, 1-celled, ca 0.75 mm long, glabrous. **Ovary** superior, ca 3 mm in diam., densely hairy, placentation axile, 5-loculed; styles 10 connate at base into tube, ca 7 mm long glabrous; free part ca 1 mm long, glabrous; stigma 10, capitate, ca 0.25 mm in diam., hairy. **Fruit** a capsule, septicidal dehiscent, dark brown, depressed-subglobose, 5-lobed, 8–10 by 5–6 mm, densely hairy and echinate. **Seeds** golden brown, ellipsoid, trigonous, ca 3 by 2.5 mm, glabrous. **Plate 7.A.**

**Thailand.**— Throughout Thailand.

**Distribution.**— Pantropics.

**Ecology.**— Common in open areas, rice fields, waysides and waste grounds. Flowering and fruiting all year round.

**Vernacular.**— Khamong dong (ขมดง) (Sukhothai); Khi khork (ขี้ครอก) (Central); Cha ba pa (ชบาป่า) (Nan); Bo-thoe (บอเทอ), Pa-tho (ปะเทาะ) (Karen-Mae Hong Son); Po seng (ปอเส็ง) (Pattani); Pu-lu (ปลู) (Malay-Narathiwat); Seng (เส็ง) (Peninsular); Ya phom yung (หญ้าพมยุง), Ya i yu (หญ้าอียู) (Northern); Ya-hua-tung (หญ้าหัวยุง) (Shan-Mae Hong Son).

**Specimen examined.**— *P. Pattarakulpisutti et al.* 239 (PSU).

## MELASTOMATACEAE

**44. *Melastoma malabathricum*** L. subsp. *malabathricum*, Sp. Pl. 1: 390.1753; C. B. Clarke in Hook. f., Fl. Brit. India (J. D. Hooker) 2: 523. 1879; Ridl., Fl. Malay Penins. 1: 764. 1922; S. S. Renner, Clausen, Cellin. & Karst. Mey. in Fl. Thailand 7(3): 441. Pl. XVIB. 2001.— *M. polyanthum* Blum in Flora 14: 480. 1831; C. B. Clarke in Hook. f., Fl. Brit. India (J. D. Hooker) 2: 523. 1879.— *M. scabrum* Ridl., J. Straits Branch Roy. Asiat. Soc. 79: 66. 1918; Fl. Malay Penins. 1: 766. 1922.

Shrub, up to 3 m high; bark reddish brown; branchlets quadrangular, covered with appressed scales. *Leaves* simple, decussate; stipule absent; petiole 7–17 mm long, covered with appressed scales; blade lanceolate, 7–12 by 2.2–3.5 cm, subcoriaceous, covered with stiff hairs and appressed scales on veins, apex acute to acuminate, margin ciliate, base cuneate to obtuse. *Inflorescences* terminal, simple to compound dichasial, 3–12-flowered; peduncle 5–7 mm long, covered with appressed scales. *Flowers* slightly actinomorphic; pedicels 4–6 mm long, covered with appressed scales; bracts ovate-lanceolate to elliptic, 15–27 by 7–12 mm, outer surface covered with appressed scales, apex acuminate, margin entire. *Hypanthium* urceolate, 11–13 by 6–10 mm, outer surface covered with appressed scales. *Calyx* pinkish-green, gamosepalous, 5-lobed; lobes lanceolate-ovate in outline, 8–10 by 3–4 mm, outer surface covered with appressed scales, apex acuminate, margin entire. *Corolla* purple, free, petals 5; obovate-oblongate, 3.5 by 1.2–1.3 cm, glabrous, apex obtuse, margin ciliate, base cuneate. *Stamens* 10, free, dimorphic; outer stamens 5, pale-pink, filaments 1.2–1.3 cm long, glabrous, pedoconnective ca 1.2 cm long, with 2 small appendages, anthers 1.1–1.1 cm long, glabrous; inner stamens 5, yellow, filaments 9–10 mm long, glabrous, anthers 8–10 mm long, glabrous. *Ovary* inferior, ca 4 mm in diam., densely hairy, placentation axile, 5-loculed; style 1, ca 2.5 cm long, glabrous; stigma 1, punctiform, glabrous. *Fruit* a capsule, transversely dehiscent, dark red, urceolate, 1.2–1.5 by 1 cm, covered with appressed scales. *Seeds* very small.

**Plate 7.B.**

**Thailand.**— NORTHERN: Chiang Mai, Chiang Rai, Nan, Phitsanulok; NORTH-EASTERN: Phetchabun; CENTRAL: Nakhon Nayok; SOUTH-EASTERN: Chanthaburi, Trat; PENINSULAR: Ranong, Surat Thani, Phangnga, Phuket, Nakhon Si Thammarat, Patthalung, Trang, Songkhla, Narathiwat.

**Distribution.**— India, Indochina, Malesia and Northern Australia.

**Ecology.**— On roadsides, rubber plantations, seasonally flooded areas and coastal heath vegetations. Flowering and fruiting all year round.

**Vernacular.**— A (อ้อ), A luang (อ้อหลวง) (Northern); Ta-la-do (ตะลาเต๊า) (Karen Mae Hong Son); Si-sa-pho (ชีวะโพ๊ะ) (Karen-Kanchanaburi); Khlong khlong (โคลงเคลง), Khlong Khlong khi ma (โคลงเคลงขี้ม้า), Khlong khlong khi nok (โคลงเคลงขี้นก) (Trat); Ma-ya (มายะ) (Chong-Trat); Be (เบร์), Mang khre (มังเกร์), Mang re (มังเร่), Mare (มะเหร), Samre (สำเร), Sare (สาร) (Peninsular); Ka-du-do (กาดูโด้) (Malay-Satun, Pattani); Ka-du-du (กะดูดู) (Malay-Pattani).

**Specimens examined.**— *P. Pattarakulpisutti et al.* 189, 366, 425 (PSU).

## MORACEAE

**45. *Streblus asper*** Lour., Fl. Cochinch. 2: 615. 1790; Hook. f. in Fl. Brit. Ind. (J. D. Hooker) 5: 489. 1888; Backer & Bakh. f., Fl. Java (Spermatoph.) 2: 16. 1965; C. C. Berg, Corner & F.M. Jarrett in Fl. Males., Ser. 1, Spermat. 17(2): 42, fig. 6. 2006.

Shrub to small tree, up to 8 m high, dbh up to 15 cm; bark whitish grey; flowering twigs 1–2 mm in diam., hairy when young; sap white; dioecious or monoecious. **Leaves** simple, distichous; stipules narrowly ovate to ovate, 1–1.25 by 1 mm, sparsely hairy, acute, entire; petiole up to 2 mm long, hairy; blade elliptic, broadly elliptic to oblong, 2.3–6 by 1.5–3.6 cm, sub-coriaceous, scabrous, apex acute, margin serrulate, base cuneate. **Inflorescences** unisexual; staminate inflorescences not seen; pistillate inflorescences axially, solitary or head of 2–3-flowered; peduncle up to 2.5 mm long, hairy; bracts deltoid to narrowly deltoid, 1–2 by 1 cm, hairy, apex acuminate, entire. **Flowers** unisexual, actinomorphic. **Staminate flowers** not seen. **Pistillate flowers** 1–2 mm in diam., sessile; bracteoles deltoid, ca 2 by 2 mm, hairy, apex acute, margin entire; perianth green, free, tepals 4 in 2 series, unequal, outer ones deltoid, ca 2 by 2 mm, scabrous, apex acute, margin ciliate, inner ones narrowly deltoid, ca 2 by 1 mm, scabrous, apex acute, margin ciliate; ovary superior, 0.75–1 mm in diam., glabrous, placentation apical, 1-loculed, style 1, 1.5–2 mm long, glabrous, stigma 2, filiform, up to 15 mm long, glabrous. **Fruit** a drupe yellow to orangish yellow, sub-globose, 5–8 mm in diam., glabrous; persistent tepals ovate to

broadly ovate, 5–8 by 5 mm, sparsely hairy, apex obtuse, margin entire. *Seed* not seen. *Plate 7.C.*

**Thailand.**— Throughout Thailand.

**Distribution.**— Sri Lanka, India, Bhutan, Bangladesh, Myanmar, Andaman Islands, Nicobar Island, Southern China, Indochina and Malesia.

**Ecology.**— Usually in open places such as secondary forests and rice fields. Flowering and fruiting from February to September.

**Vernacular.**— Kak mai foi (กักไม้ฝอย) (Northern); Khoi (ข่อย) General; Sa-yo-se (ชะโยเส) (Karen-Mae Hong Son); Tong-khs-nae (ตองกะแห่น) (Karen-Kanchanaburi); Som pho (ส้มพ้อ) (Loei); Sa-nai (สะนาย) (Khmer).

**Specimens examined.**—*P. Pattarakulpisutti et al.* 227, 496, 654 (PSU).

**46. *Streblus perakensis*** Corner, Gard. Bull. Singapore 19: 223. 1962; C. C. Berg, Corner & F. M. Jarrett in Fl. Males., Ser. 1, Spermat. 17(2): 58. 2006.

Scandent to shrub, up 6–7 m high, dbh 15–20 cm; bark grayish white; flowering twigs 1–3 mm in diam., lenticellate and hairy when young, with terminal or lateral thorns, ca 1 cm long; sap white; dioecious. *Leaves* simple, distichous; stipules narrowly deltoid, 2 by 0.5–1 mm, sparsely hairy, acuminate, ciliate; petiole 2–5 mm long, hairy; blade narrowly elliptic to elliptic oblong, 4.2–13 by 1.5–4.2 cm, chartaceous, glabrescent at upper surface, apex acuminate to emarginate, margin serrulate, undulate, base obtuse to truncate. *Inflorescences* unisexual; staminate inflorescences axially, head, 3–5-flowered; peduncle up to 1.5 mm long, glabrous; bracts narrowly deltoid, ca 2 by 1 cm, glabrous, apex acute, ciliate; pistillate inflorescences axially, solitary or in pairs, sessile; bracts narrowly deltoid, ca 2 by 1 cm, glabrous, apex acute, ciliate. *Flowers* unisexual, actinomorphic. *Staminate flowers* ca 2 mm in diam., sessile; bracteoles ovate, ca 2 by 1 mm, apex obtuse, margin entire; perianth white, free, tepals 4, broadly ovate, ca 2 by 1.5 mm, glabrous,

apex obtuse, margin entire; pistillode bilobed, ca 0.5 by 0.25 mm, hairy; stamens 4, free, filaments 1.75–2 mm long, glabrous, anthers dorsifixed, 2-celled, ca 1 mm long, glabrous. **Pistillate flowers** actinomorphic, ca 2 mm in diam., sessile; bracteoles ovate, ca 2 by 1 mm, apex obtuse, margin entire; perianth green, free, tepals 4 in 2 series, unequal, outer ones broadly ovate to orbicular, 1–1.5 by 1.5–2 mm, glabrous, apex obtuse, margin ciliolate, inner ones ovate, ca 1.5 by 1 mm, glabrous, apex obtuse, margin ciliolate; ovary superior, ca 1 mm in diam., glabrous, placentation apical, 1-loculed, style 1, ca 0.5 mm long, glabrous, stigma 2, filiform, up to 3–3.5 mm long, hairy. **Fruit** a drupe, green, sub-globose, 8–12 mm in diam., glabrous; persistent tepals orbicular, 3–4 mm in diam. for inner ones and ca 10 mm in diam. for outer ones, glabrous, apex obtuse, margin entire. **Seed** not seen. **Plate 7.D.**

**Thailand.**— PENINSULAR: Trang.

**Distribution.**— Peninsular Malaysia.

**Ecology.**— In understory of seasonally floodplain vegetations. Flowering and fruiting from January to June.

**Vernacular.**—

**Specimens examined.**— *P. Pattarakulpisutti et al.* 206, 209, 223, 390 (PSU).

## OLACACEAE

**47. *Olax psittacorum*** Vahl, Enum. Pl. (Vahl) 2. 33. 1805.— *O. scandens* Roxb., Pl. Coromandel 2. 2. t. 102. 1798; Mast., in Hook. f., Fl. Brit. India (J. D. Hooker) 1: 575. 1875; Ridl., Fl. Malay Penins. 1: 421. 1922.

Scandent shrub; flowering twigs ca 2 mm in diam., sparsely hairy. **Leaves** simple, alternate; stipules deltoid, ca 1 by 0.5 mm, sparsely hairy, apex acute, margin entire; petiole 6–8 mm long, glabrous; blade lanceolate-ovate, 6–9 by 3.5–4.1 cm, coriaceous, glabrous, apex sub-acute, margin crenulate, base obtuse to truncate. **Inflorescences** axillary, short panicle; peduncle very short; rachis 4–7 mm long,



hairy; bracts deltoid, ca 1 by 1 mm, hairy, apex acute, margin entire. **Flowers** actinomorphic, 7–8 mm in diam., fragrant; pedicels 1–2 mm, glabrous; bracteoles deltoid, ca 1 by 1 mm, hairy, apex acute, margin entire. **Calyx** light green, gamosepalous, campanulate, persistent, glabrous; tube ca 1 by 0.5 mm; lobes indistinct, margin ciliolate. **Corolla** white, gamopetalous, salverform, 4–5-lobed, glabrous; tube ca 4 by 1 mm; lobes linear-oblong, 4–6 by 1–1.5 mm, apex acute, margin entire. **Stamens** 3, free, epipetalous; filaments ca 3 mm long, glabrous; anthers dorsifixed, 2-celled, ca 1.5 mm long, glabrous; staminodes 5, ca 4 mm long, bilobed, glabrous. **Ovary** superior, ca 1 mm in diam., glabrous, placentation axile, 3-loculed; style 1, ca 3 mm long, glabrous; stigma 1, capitate ca 0.25 mm in diam., glabrous. **Fruit** a drup, green, broadly ovoid, 8–10 by 7–8 mm, enclosed two third of its length by persistent calyx, glabrous. **Seed** not seen. **Plate 7.E.**

**Thailand.**— EASTERN: Nakhon Ratchasima; PENINSULAR: Trang, Songkhla.

**Distribution.**— India, Peninsular Malaysia and Java.

**Ecology.**— Usually found on open areas, roadsides, secondary vegetation and coastal heath vegetations. Flowering and fruiting all year round.

**Vernacular.**— Krado kok (กระดอออก) (Suphanburi); Krado (กระเดาะ) (Songkhla); Kra-do-a-ching (กระเดาะอาจิง) (Malay-Narathiwat); Kra thok (กระทอก), Chak kra thok (ชักกระทอก) (Prachuap khiri khan); Kra thok ma (กระทอกม้า) (Ratchaburi); Kra thok rok (กระทอกรอก) (Central); Khuai siak (ควยเขียก) (Nakhon Ratchasima); Nang chum (นางชม) (Northern); Nam chai khrai (น้ำใจไคร้) (Ratchaburi, Kanchanaburi); Phak rut (ผักรูด) (Surat Thani).

**Specimens examined.**— *P. Pattarakulpisutti et al* 241, 510, 640 (PSU).

**PHYLLANTHACEAE**

**48. *Antidesma ghaesembilla*** Gaertn., Fruct. Sem. Pl. 1: 189. 1788; Petra Hoffm., Thai Forest Bull., Bot. 28: 147. 2000; Welzen & Chayam. in Fl. Thailand. 8(1): 65. 2005.

Shrub, up to 2.5 m high, dbh 10–15 cm; bark dark grey; flowering twigs 2–3 mm in diam., densely hairy when young; dioecious. *Leaves* simple, alternate; stipules caducous; petiole 0.5–1 cm long, hairy; blade elliptic, oblong to orbicular, 2.5–7.5 by 2–4 cm, sub-coriaceous, hairy only at veins, apex obtuse to truncate, margin entire, base obtuse to truncate. *Inflorescences* axillary, raceme-like, branching; staminate inflorescences much-branched, 10–15 racemes, peduncle 2–8 mm, densely hairy, rachis 2–5 cm, densely hairy, bracts narrowly deltoid, 1–2 by 0.5 mm, densely hairy, apex acuminate, margin entire; pistillate inflorescences usually 2–3 racemes, peduncle 5–10 mm, densely hairy, rachis 1.2–2 cm, densely hairy, bracts same as staminate one. *Flowers* unisexual, actinomorphic; calyx free, sepals 4–6, hairy outside, glabrous inside; corolla absent. *Staminate flowers* ca 1.5 mm in diam.; pedicels very short; sepals yellowish green, ovate, ca 0.5 by 0.5 mm, apex acute, margin entire; disc 4–6-lobes, lobes obconical, ca 0.5 by 0.5 mm, hairy; stamens 4–6, free, filaments ca 2 mm long, glabrous, anthers versatile, 2-celled, ca 0.5 mm long, glabrous; pistillode lanceolate, ca 1 by 0.5 mm, hairy. *Pistillate flowers* ca 1 mm in diam.; pedicels up to 1 mm, hairy; sepals light green, deltoid; ca 0.5 by 0.5 mm, apex acute, margin entire; ovary superior, ca 1 mm in diam., hairy, placentation apical, 1-loculed, style absent, stigma 2–6, ca 0.5 mm long, glabrous. *Fruit* and *Seed* not seen. **Plate 7.F.–G.**

**Thailand.**— NORTHERN: Mae Hong Son, Chiang Mai, Chiang Rai, Lamphun, Lampang, Tak, Phitsanulok, Nakhon Sawan; NORTH-EASTERN: Phetchabun, Loei, Khon Kaen; EASTERN: Nakhon Ratchasima, Buri Ram, Si Sa Ket; SOUTH-WESTERN: Kanchanaburi, Ratchaburi, Phetchaburi, Prachuap Khiri Khan; CENTRAL: Ang Thong, Bangkok; SOUTH-EASTERN: Chon Buri, Chanthaburi; PENINSULAR: Chumphon, Surat Thani, Phangnga, Nakhon Si Thammarat, Trang, Songkhla, Yala, Narathiwat.

**Distribution.**— India, Nicobar Islands, Sri Lanka, Southern China, Bangladesh, Indochina, Malesia and Northern Australia.

**Ecology.**— Usually in secondary vegetations, range from dry to inundated soil, in seasonally flooded areas, mounds in rice fields and roadsides. Flowering and fruiting all year round.

**Vernacular.**— Khamao pha (ขะเม่าผา), Mamao (มะเม่า) (Northeastern); Mao khai pla (เม่าไข่ปลา) (Chon Buri); Mang mao (มังเม่า) (Chanthaburi); Ma mao khao bao (มะเม่าข้าวเบา) (Chumphon); Mao thung (เม่าทุ่ง) (Chumphon, Songkhla); Ku-chaе (กูแจ) (Malay-Narathiwat).

**Specimens examined.**— *P. Pattarakulpisutti et al.* 185, 193, 237, 238 (PSU).

**49. *Breynia vitis-idaea*** (Burm. f.) C. E. C. Fisch., Bull. Misc. Inform., Kew 1932(2): 65. 1932; Whitmore, Tree Fl. Mal. 2: 73. 1973; Welzen *et al.*, Thai Forest Bull., Bot. 28: 77. 2000; Welzen & Chayam. in Fl. Thailand. 8(1): 140. 2005.

Shrub, up to 1.5 m high; flowering twig 1–2 mm in diam., glabrous; monoecious. **Leaves** simple, distichous; stipules deltoid, ca 2 by 1 mm, glabrous, apex acute, margin entire; petiole 1–2 mm long, glabrous; blade obovate, elliptic to orbicular, 1.5–3.3 by 1.2–2.3 cm, membranous, glabrous, apex oblong to emarginated, margin entire, base obtuse. **Inflorescences** axillary, pistillate flower solitary at the top of branches; staminate flowers fasciculated at the lower nodes; bracts deltoid, ca 2 by 1 mm, glabrous. **Flowers** unisexual, actinomorphic; calyx gamosepalous, campanulate, 6-lobed, glabrous; corolla absent. **Staminate flowers** ca 1.5 mm in diam.; pedicels up to 4 mm long, glabrous; calyx green, fleshy, tube ca 1.5 by 2 mm, lobes indistinct; stamens 3, connate into androphore, ca 1 mm long, anthers along androphore, 2-celled, extrorse, ca 1 mm long, glabrous, connective teeth ca 0.1 mm long, glabrous. **Pistillate flowers** ca 1.5 mm in diam.; pedicels up to 2 mm, glabrous; calyx green, persistent, tube ca 1 by 2 mm, lobes deltoid, ca 0.2 mm long, apex acute, margin entire; ovary superior, ca 1.5 mm in diam., glabrous, placentation axile, 3-

loculed; style absent, stigma 3 persistent, ca 0.1 mm long, glabrous. **Fruit** a capsule, loculicidal dehiscent, red, depressed-subglobose, 3–5 by 3 cm, glabrous. **Seeds** light brown, crescent, trigonous, ca 3 by 2 mm, glabrous. **Plate 7.H.**

**Thailand.**— NORTHERN: Chiang Mai, Lamphun; EASTERN: Nakhon Ratchasima, Ubon Ratchathani; CENTRAL: Saraburi, Nakhon Nayok, Bangkok; SOUTH-EASTERN: Prachin Buri, Chon Buri, Chanthaburi, Trat; PENINSULAR: Chumphon, Ranong, Surat Thani, Phangnga, Krabi, Nakhon Si Thammarat, Phatthalung, Yrang, Satun, Songkhla.

**Distribution.**— India, Sri Lanka, Myanmar, Indochina and Peninsular Malaysia.

**Ecology.**— On roadsides, old rice fields, mound on rice fields and forest edges. Flowering and fruiting all year round.

**Vernacular.**— Dap phit (ดัดพิษ), Phia fan (เพี้ยฟาน) (Northern); Kang pla thale (ก้างปลาทะเล) (Narathiwat); Phak wan tua phu (ผักหวานตัวผู้) (Central).

**Specimens examined.**— *P. Pattarakulpisutti et al.* 195, 501 (PSU).

**50. *Flueggea virosa*** (Roxb. ex Willd.) Royle, Ill. Bot. Himal. Mts. (Royle) 9: 328. 1836.— *F. virosa* (Willd.) Voigt, Hort. Suburb. Calc.: 152. 1845; Welzen & Chayam. in Fl. Thailand. 8(1): 301. 2005.

Shrub, 1–3 m high; young branche quadrangular, glabrous to sparsely hairy; dioecious. **Leaves** simple, distichous; stipules narrowly deltoid, ca 1 by 1 mm, glabrous, apex acuminate, margin entire; petiole 2–5 mm long, glabrous; blade broadly ovate to broadly elliptic, 1–5 by 0.9–3.2 cm, sub-membranous, glabrous to sparsely hairy, apex sub-acute to obtuse, margin entire, base cuneate to obtuse. **Inflorescences** axillary, fasciculated, 3–7-flowered. **Flowers** unisexual, actinomorphic; calyx free; sepals 5, outer two smaller than inner threes, glabrous to sparsely hairy; corolla absent; bracts deltoid, ca 1 by 0.5 mm, glabrous, apex acute, margin ciliolate. **Staminate flowers** ca 1 mm in diam.; pedicels up to 2 mm long,

sparsely hairy; calyx light green to greenish white, outer ones narrowly elliptic, ca 1.5 by 1 mm, apex sub-acute, margin entire, inner ones obovate-lanceolate, ca 1.5 by 1 mm, apex obtuse, margin entire; disc of 5 separate glands, glabrous; stamens 5, free, filaments, up to 2 mm long, glabrous; anthers dorsifixed, 2-celled, ca 0.75 mm long, glabrous; pistillode 3, apex bifid, glabrous. *Pistillate flowers* ca 1.5 mm in diam.; pedicels up to 2 mm long, glabrous; calyx light green to greenish white, outer ones broadly deltoid, ca 0.5 by 0.5 mm, apex acuminate, margin entire, inner one elliptic oblong, ca 1 by 1 mm, apex obtuse, margin entire; disc annular, glabrous; ovary superior, ca 1 mm in diam., glabrous; placentation axile, 3-loculed, style 3, ca 0.5 mm long, glabrous, stigma bifid, persistent, 0.5–0.75 mm long, glabrous. *Fruit* drupaceous, white, depressed-subglobose, 4–6 by 6–7 mm, glabrous. *Seed* brown, crescent, trigonous, ca 2 by 1 mm, glabrous. **Plate 8.A.–B.**

**Thailand.**— NORTHERN: Mae Hong Son, Chiang Mai, Chiang Rai, Nan, Lampang, Tak, Nakhon Sawan; EASTERN: Chaiyaphum, Nakhon Ratchasima; SOUTH-WESTERN: Kanchanaburi, Phetchaburi, Prachuap Khiri Khan; SOUTH-EASTERN: Rayong, Chanthaburi, Prachuap Khiri Khan; CENTRAL: Saraburi, Nakhon Nayok; SOUTH-EASTERN: Rayong, Chanthaburi; PENINSULAR: Surat Thani, Trang.

**Distribution.**— Tropical Africa and Asia, Japan, Australia and Polynesia.

**Ecology.**— Very common in marshlands, old rice fields and roadsides, usually in secondary vegetations. Flowering and fruiting from June to September.

**Vernacular.**— Kangpla (ก้างปลา), Kang pla khao (ก้างปลาขาว) (General); Daeng nam (แดงน้ำ), Kangpla daeng (ก้างปลาแดง), Ma taek (มะเตก), Mae-ko-pla (แม่กอปลา) (Karen-Mae hong Son), Ta-kho-lo-khue (ตาข้อโลค็ย) (Karen-Mae Hong Son) (Northern).

**Specimens examined.**— *P. Pattarakulpisutti et al.* 364, 437, 439 (PSU).

**51. *Glochidion obscurum*** Blume, Bijdr. Fl. Ned. Ind. 12: 585. 1826; Hook. f. in Fl. Brit. India (J. D. Hooker) 5: 317. 1887; Ridl., Fl. Malay. Penin. 3: 208. 1924; Corner, Wayside Tree of Malaya 1: 287. 1940; Backer & Bakh. f., Fl. Java (Spermatoph.) 1: 461. 1963; Airy Shaw, Kew Bull. 26(2): 279. 1972; Whitmore, Tree Fl. Mal. 2: 99. 1973; Welzen *et al.*, Thai Forest Bull., Bot. 28: 90. 2000; Welzen & Chayam. in Fl. Thailand. 8(2): 324. 2007.

Shrub to small tree, up to 6 m high, dbh 10–15 cm; bark vertically cracked, grey to light brown; flowering twigs ca 2 mm in diam., densely hairy; sap white; monoecious. **Leaves** simple, distichous; stipules caducous, falcate-deltoid, ca 1 by 1 mm, hairy outside, apex acute, margin entire; petiole 2–3 mm long, hairy; blade elliptic-oblong to oblong, 2.5–5 by 1.2–2.2 cm, sub-coriaceous, hairy, apex acute to obtuse, margin entire, base strongly oblique. **Inflorescences** axillary, fasciculated, often consist of 2 staminate flowers and 1 pistillate flower. **Flowers** unisexual actinomorphic; calyx free, sepals 6 in 2 series, hairy outside, outer sepals larger; corolla absent; bracts deltoid, up to 1 by 1 mm, hairy, apex acute, margin entire. **Staminate flowers** ca 5 mm in diam.; pedicels up to 6 mm long, hairy; calyx greenish yellow, outer ones obovate to elliptic, ca 3 by 2 mm, apex acute, margin entire, inner ones oblanceolate to obovate, ca 3 by 1.5 mm, apex acute, margin entire. **Stamens** 6, connate into androphore, ca 1 mm long; anthers along androphore, extrorse, 4-celled; connective teeth 6, ca 0.2 mm long, glabrous. **Pistillate flowers** ca 4 mm in diam.; pedicels 1–1.5 cm in fruit, hairy; calyx light green, persistent, deltoid, outer ones 1.5–2 by 0.6–1 mm, apex acute, margin entire, inner ones ca 1 by 0.6 mm, apex acute, margin entire. **Ovary** superior, ca 2 mm in diam., hairy, placentation axile, 9-loculed, style absent, stigma in a long cone, persistent, ca 1.5 mm long, apically toothed, glabrous. **Fruit** a capsule, loculicidal dehiscent, green, depressed-subglobose, ca 1.9 by 2 cm, hairy, sutures slightly raised; wall ca 2 mm thick. **Seeds** red, crescent, trigonous, ca 6 by 4 mm, glabrous. **Plate 8.C.**

**Thailand.**— SOUTH-WESTERN: Phetchaburi; PENNINSULAR: Ranong, Phangna, Phuket, Trang, Satun, Yala.

**Distribution.**— Indochina, Malesia (except Philippines).

**Ecology.**— In secondary vegetations, open thicket along rivers and streams. Flowering and fruiting all year round.

**Vernacular.**— Khram (ครำ) (Satun); Marua (มะรัว) (Nakhon Si Thammarat); Ruat (รวต) (Phangnga).

**Specimens examined.**— *P. Pattarakulpisutti et al.* 397, 458 (PSU); *J.F. Maxwell* 86–928, 86–1068 (PSU); *T. Santisuk* 1265 (PSU).

**52. *Glochidion rubrum*** Blume, Bijdr. Fl. Ned. Ind. 12: 586. 1826; Backer & Bakh. f., Fl. Java (Spermatoph.) 1: 464. 1963; Airy Shaw, Kew Bull. 26(2): 279. 1972; Whitmore, Tree Fl. Mal. 2: 101. 1973; Welzen *et al.*, Thai Forest Bull., Bot. 28: 90. 2000; Welzen & Chayam. in Fl. Thailand. 8(2): 324, fig. 5a-f, pl. XVII3. 2007.— *G. coronatum* Hook. f., Fl. Brit. India (J. D. Hooker) 5: 326. 1887.

Shrub, 1–3 m high, dbh up to 5 cm; bark light-brown; flowering twigs ca 2 mm in diam., sparsely hairy; monoecious. **Leaves** simple, distichous; stipules narrowly deltoid, ca 2 by 1 mm, sparsely hairy, apex acute, margin entire; petiole 2–3 mm long, sparsely hairy; blade narrowly elliptic or elliptic to obovate, 2.5–7 by 1.5–2.5 cm, sub-coriaceous, glabrous, apex bluntly acuminate to cuspidate, margin entire, base attenuate. **Inflorescences** axillary, fasciculated, 3–15-flowered, often consist of few staminate and/or pistillate flowers. **Flowers** unisexual actinomorphic; calyx free, sepals 6 in two series, glabrous to sparsely hairy, outer sepals larger; corolla absent; bracts narrowly deltoid, 1–1.5 by 0.5–0.75 mm, sparsely hairy, apex acuminate, margin entire. **Staminate flowers** ca 5 mm in diam.; pedicel 4–6 mm long, glabrous to sparsely hairy; sepals yellowish to pinkish-white, outer ones ovate-lanceolate, ca 3 by 1 mm, apex acute, margin entire, inner ones oblanceolate, ca 2 by 1 mm, apex acute, margin entire; stamens 3, connate into androphore, ca 1 mm long; anthers along androphore, extrorse, 2-celled, connective teeth 3, ca 0.25 mm long, glabrous. **Pistillate flowers** ca 1 mm in diam.; pedicels very short, glabrous to sparsely hairy; sepals yellowish to pinkish-white, outer ones ovate-lanceolate, ca 1.5 by 1 mm, apex acuminate, margin entire, inner one lanceolate, ca 1 by 0.5 mm, apex acute, margin entire; ovary superior, ca 1 mm in diam., hairy, placentation axile, 3-loculed; stigma

3, in a long cone, persistent, ca 1 mm long, apically toothed, sparsely hairy. **Fruit** a capsule, loculicidal, pink to red, depressed-subglobose, 5–7 by 3 mm, sparsely hairy. **Seeds** red, crescent, trigonous, ca 4 by 2 mm, glabrous. **Plate 8.D.**

**Thailand.**— NORTHERN: Mae Hong Son, Chiang Mai, Chiang Rai, Tak; EASTERN: Nakhon Ratchasima, Si Sa Ket, Ubon Ratchathani; SOUTH-WESTERN: Kanchanaburi; SOUTH-EASTERN: Trat; PENINSULAR: Ranong, Surat Thani, Phangnga, Phuket, Krabi, Nakhon si Thammarat, Phatthalung, Trang, Satun, Songkhla, Narathiwat.

**Distribution.**— Indochina, Malesia, Maluku and Lesser Sunda Islands.

**Ecology.**— Very common in marshlands, old rice fields, along roads and usually on secondary vegetations. Flowering and fruiting all year round.

**Vernacular.**— Kradum phi (กระดุมผี) (Ranong); Kue-nong (ก๊ือนอง) (Malay-Peninsular); Khatna (ขัตนะ) (Trang); Chumset (ชุมเส็ด), Ma ruat (มะรวาด) (Surat Thani); Tana (ตานา) (Nong Khai); Nok non (นกกอน) (Narathiwat).

**Specimens examined.**— *P. Pattarakulpisutti et al.* 183, 266 (PSU).

**53. *Hymenocardia punctata*** Wall. ex Lindl., Nat. Syst. Bot., ed. 2., 441. 1836; Hook. f. in Fl. Brit. India (J. D. Hooker) 5: 376. 1887; Whitmore, Tree Fl. Mal. 2: 103. 1973; Welzen & Chayam. in Fl. Thailand. 8(2): 341, fig. 10, pl. XIX1. 2007.

Shrub, up to 3 m high, dbh ca 5 cm; bark grey; flowering twigs 2-3 mm in diam., glabrous; dioecious. **Leaves** simple, alternate; stipules caducous; petiole 7–10 mm long, hairy; blade elliptic-ovate to elliptic, 2.5–10 by 2–5 cm, subcoriaceous, lower surface densely scaly, apex acute to retuse, margin entire, base cuneate to obtuse. **Inflorescences** axillary; staminate catkins; peduncle absent; rachis up to 2.5 cm long, hairy; bracts narrowly deltoid, ca 1 mm long, hairy, apex acuminate, margin entire; pistillate raceme, peduncle 8–13 mm long, glabrous, rachis 3–10 mm long, glabrous, bracts same as staminate. **Flowers** unisexual, actinomorphic; calyx free, sepals 4–6, glabrous; corolla absent; bracteoles peltate, stalk ca 1 mm long,



sparsely hairy, blade deltoid ca 1 by 1 mm, hairy and scary. **Staminate flowers** ca 2 mm in diam.; pedicels very short; calyx brown, close in bud splitting in to 2–5 segments, deltoid to elliptic-oblong, ca 1 mm long, hairy and scary, apex obtuse to acute, margin entire; pistillode ca 2 mm, glabrous; stamens 5, united with pistillode, ca 2 mm long, free part up to 1.5 mm long, glabrous, anthers dorsifixed, 2-celled, ca 1 mm long, glabrous. **Pistillate flowers** not seen. **Fruit** green, heart-shaped, flattened, 1.6–1.7 by 1–1.3 cm, glabrous. **Seed** not seen.

**Thailand.**— NORTHERN: Sukhothai, Nakhon Sawan; EASTERN: Nakhon Ratchasima, Si Sa Ket; SOUTH-EASTERN: Prachin Buri (Ban Mueang Kao), Chanthaburi; PENINSULAR: Surat Thani, Trang.

**Distribution.**— Indochina, Peninsular Malaysia and Sumatra.

**Ecology.**— Usually found along rivers, streams, ponds and marshlands. Flowering from March to April, fruiting from March to September.

**Vernacular.**— Kang pla khao (ก้างปลาขาว) (Sukhothai); Mak faep (หมักแฟบ) (Phitsanulok); Hu ling (หูลิง) (Nakhon Ratchasima); Hu dang (หูด่าง) (Surin); Faep nam (แฟบน้ำ) (Prachuap Khiri Khan); Khwaep (แควบ), Faep (แฟบ) (Chon Buri); Faep Hua ling (แฟบหัวลิง) (Peninsular).

**Specimens examined.**— *P. Pattarakulpisutti et al.* 218, 641 (PSU).

## POLYGALACEAE

**54. *Salomonina longiciliata*** Kurz, J. Asiat. Soc. Bengal, Pt. 2, Nat. Hist. 59: 292. 1872; Ridl., Fl. Malay. Penin. 1: 140. 1924; Pendry in Fl. Thailand. 7(3): 523. 2001.

Herb, 12–20 cm high; stem ridged, glabrous to sparsely hairy, branched or not. **Leaves** simple, alternate, sessile; blade lanceolate rarely ovate, 4–8 by 1–4 mm, chartaceous, glabrous, apex acuminate, margin entire to ciliolate, base truncate. **Inflorescences** terminal, spike, many flowered; peduncle very short, glabrous; rachis 3–12 cm long, glabrous. **Flowers** zygomorphic; sessile; bracts lanceolate, ca 1 by 0.5 mm, sparsely hairy, apex acuminate, margin ciliolate. **Calyx**

green, pink at apex, connate with short tube, 5-lobed, sparsely hairy; tube very short; lobes lanceolate, ca 1 by 0.5 mm, apex acuminate, margin ciliolate. **Corolla** pink to purple, connate with short tube, 3-lobed, unequal, glabrous; tube very short; upper petals connate with keels at lower part, ovate in outline, ca 1 by 0.5 mm, apex obtuse, margin entire; keels oblanceolate in outline, ca 3 by 1 mm, apex retuse, margin entire. **Stamens** 4, connate into a staminal sheath, up to 2 mm long, margin ciliolate; anthers basifixed, 1-celled, ca 0.25 mm long, glabrous. **Ovary** superior, ca 1 mm in diam., with double row of spines along margin, placentation axile, 2-loculed; style up to 2 cm long, glabrous; stigma 1, punctiform. **Fruit** a capsule, loculicidal dehiscent, green, pink or purple along margin, reniform, ca 2.3 by 1 mm, with spine along margin, up to 0.5 mm long, face of lower capsule with minute hairs. **Seeds** black, ovate, laterally flattened, ca 6 by 4 mm, glabrous. **Plate 8.E.**

**Thailand.**— NORTERN: Mae Hong Son, Chiangmai; NORTH-EASTERN: Loei; EASTERN: Nakhon Ratchasima; CENTRAL: Nakhon Nayok, Saraburi; SOUTH-EASTERN: Prachin Buri, Trat; PENINSULAR: Trang, Songkhla.

**Distribution.**— Myanmar, Cambodia, Vietnam, Borneo and Philippines.

**Ecology.**— In seasonally flooded areas, old rice fields and open areas. Flowering and fruiting all year round.

**Vernacular.**— Niem ton pik (เนียมต้นปีก), Ya rak hom (หญ้าarakหอม) (North-eastern).

**Specimens examined.**— *P. Pattarakulpisutti et al.* 375, 456 (PSU).

**55. *Xanthophyllum eurhynchum*** Mig., Ann. Mus. Bot. Lugduno-Batavi 1: 277. 1864; Pendry in Fl. Thailand. 7(3): 527. 2001.— *X. maingayi* Hook. f. ex A. W. Benn., A.W. Benn. in Fl. Brit. Ind. (J. D. Hooker) 1: 210. 1872; Ng in Whitmore, Tree Fl. Mal. 1: 360, fig. 3. 1972.— *X. palembanicum* Miq., Ridl., Fl. Mal. Pen. 1: 149. 1922.

Small tree, 4–6 m high, dbh 25–30 cm; bark grey; branchlets 2–3 mm in diam., sparsely hairy. **Leaves** simple, alternate; petiole 5–6 mm long, sparsely hairy; blade narrowly elliptic to elliptic, 4.5–9.5 by 1.5–3.5 cm, sub-coriaceous, glabrous, apex acuminate, margin undulate, base cuneate. **Inflorescences** axillary, raceme, ca 30-flowered; peduncle very short, hairy; rachis 4.5–7.5 cm long, hairy; bracts deltoid, ca 1.1 by 1 mm, hairy, apex acuminate, margin entire. **Flowers** zygomorphic; pedicels ca 1 mm long, hairy; bracteoles lanceolate, 1–1.5 by 0.5 mm, hairy, apex acute, margin entire. **Calyx** yellowish pink, free, sepals 5, unequal, hairy outside; inner sepals deltoid, 2–2.5 by 1–1.5 mm, apex obtuse, margin entire; outer sepals deltoid-orbicular to orbicular, 3–4 by 3 mm, apex retuse, margin entire. **Corolla** pale-pink, upper petal yellow inside at base, free, petals 5, unequal, hairy at base and outside at apex; upper petals narrowed-oblongate, 8–9 by 3–4 mm, apex obtuse, margin entire; lateral petals oblongate 8–9 by 4–5 mm, apex obtuse, margin entire; keel ovate in outline, ca 7 by 8 mm, apex sub-acute, margin entire. **Stamens** 8, free; filaments 7–9 mm long, hairy at lower half; anthers basifixed, 2-celled, up to mm long, hairy at base. **Ovary** superior, ca 2 mm in diam., densely hairy, placentation parietal, 1-loculed; style 1, sparsely hairy; stigma 1, capitate, ca 0.25 mm in diam., hairy. **Fruits** a berry, grey-green, globular, up to 2 cm in diam., densely short hairy. **Seeds** not seen. **Plate 8.F.**

**Thailand.**— PENINSULAR: Ranong, Phangnga, Krabi, Trang, Songkhla, Pattani, Narathiwat.

**Distribution.**— Sumatra, Malay Peninsula.

**Ecology.**— In understory of river floodplain vegetations, along rivers and streams. Flowering in March, fruiting from March to August.

**Vernacular.**— Chum saeng nam (ชุมแสงน้ำ), Kra duk kai (กระดุกไก่อ) (Narathiwat); Chumsaeng khai (ชุมแสงไข่) (Peninsular); Ni-leng (นี่เล็ง) (Malay-Narathiwat).

**Specimens examined.**— *P. Pattarakulpisutti et al.* 221, 279 (PSU).

## POLYGONACEAE

56. *Persicaria attenuata* (R.Br.) Soják, Preslia 46(2): 152. 1974.— *Polygonum tomentosum* Willd., Ridl., Fl. Malay. Penin. 3: 11. 1924.

Aquatic herb, 60 cm high or more; stem 5–8 mm in diam., densely hairy. *Leaves* simple, alternate; stipules ochrea, 1.3–1.5 cm long, densely hairy; petiole up to 3 mm long, densely hairy; blade lanceolate, 4–12 by 0.9–3 cm, chartaceous, densely hairy, apex acuminate, margin entire, base attenuate. *Inflorescences* terminal, spike-like, branched; peduncles up to 1.5 cm long, densely hairy; bracts enclose base of peduncle, 6–10 mm long, sparsely hairy. *Flowers* actinomorphic, ca 3 mm in diam., sessile; bracteoles obovate in outline, ca 2 by 2 mm, densely hairy, apex obtuse-truncate, margin entire. *Calyx* white, persistent, connate with short tube, campanulate, 5-lobed, glabrous; tube ca 1 by 2 mm; lobes oval, ca 3 by 2 mm, apex obtuse, margin entire. *Corolla* absent. *Stamens* 6–7, free, epipetalous; filaments 1.5–2 mm long, glabrous; anthers dorsifixed, 2-celled, ca 1 mm long, glabrous. *Ovary* superior, ca 3 mm in diam., glabrous, placentation basal, 1-loculed; style 2 connate at base, ca 1 mm long, glabrous; stigma 2, capitate, ca 0.25 mm in diam., glabrous. *Fruit* a nut, black, reniform-orbicular, biconvex, ca 3 by 3 mm, glabrous. *Seed* not seen.

**Thailand.**— Throughout Thailand.

**Distribution.**— Africa and tropical Asia.

**Ecology.**—Very common on shallow waters, canals and rice fields and. Flowering and fruiting depend on flood period.

**Vernacular.**— Phak pain nam (ผักไผ่น้ำ) (Northern).

**Specimen examined.**— *P. Pattarakulpisutti et al* 174 (PSU).

## RANNANCULACEAE

**57. *Naravelia dasyoneura*** Korth., Ned. Kruidk. Arch. 1: 208. 1848; Tamura, Thai Forest Bull., Bot. 25: 74. 1997.

Vine; stem 1.5–2 mm in diam., hairy. **Leaves** trifoliate, opposite; petiole up to 2 cm long, hairy; petiolules up to 8 mm long, hairy; terminal leaflet modified to tendril, up to 5 cm long, hairy; lateral leaflets ovate, 2–5.5 by 1.2–3.5 cm, hairy at veins, apex acute, margin entire, base truncate. **Inflorescences** simple axillary and terminal cyme; peduncle up to 3 cm long, hairy. **Flowers** actinomorphic, 2–3 cm in diam.; pedicels 2.5–3 mm long, hairy; bracts filiform, 2–3 mm long, hairy. **Calyx** dark red, free, sepals 5, ovate to lanceolate ovate, 5–6 by 1.5–3 mm, sparsely hairy outside, apex acute, margin entire. **Corolla** yellowish green, free, petals 12, glabrous, linear, terete, 16–20 by 1 mm, apex obtuse, margin entire. **Stamens** numerous, free; filaments ellipsoid, 2.5–3 by 1 mm, glabrous; anthers along filaments, introrsed, 2-celled, 2.5–3 mm long. **Ovary** superior, of many free carpels, ca 1 mm in diam., hairy, placentation marginal; style absent; stigma 1, ca 1 mm in diam., hairy. **Fruits** aggregate; fruitlet an achene, brown, linear, 23–25 by 2 mm, hairy. **Seed** not seen.

**Thailand.**— CENTRAL: Bangkok; NORTH-EASTERN: Nakhon Phanom; PENINSULAR: Trang, Yala, Pattani.

**Distribution.**— Indochina, Peninsular Malaysia, Philippines, Java and Borneo.

**Ecology.**— Climbing on woodlands in seasonally flooded vegetations. Flowering from March to May, fruiting from June to August.

**Vernacular.**— Mali wan (มะลิวัลย์) (Bang kok); Hon haen (ฮอนแฮน) (Nakhon Phanom, Yala).

**Specimens examined.**— *P. Pattarakulpisutti et al.* 225, 383, 440 (PSU).

## RHAMNACEAE

**58. *Ziziphus oenopolia*** (L.) Mill., Gard. Dict., ed. 8. 1768; M. A. Lawson in Fl. Brit. India 1 (J. D. Hooker): 634. 1875; Ridl., Fl. Malay. Penin. 1: 462. 1922; Y. L. Chen & Schir. in Fl. China 12: 122, fig. 124. 2007.

Thorny shrub, up to 3 m high; flowering twigs 1–3 mm in diam., hairy throughout. *Leaves* simple, alternate; stipules filiform, 2–3 mm long, densely hairy, apex acute, margin entire; petiole 3–6 mm long, densely hairy; blade obliquely ovate to lanceolate ovate, 1.8–5 by 0.9–3 cm, sub-coriaceous, hairy at upper surface and red villous at lower surface, apex acute, margin entire, base oblique. *Inflorescences* axillary, compound dichasial, 12–15-flowered; peduncle up to 4 mm long, hairy; bracts filiform, ca 1 mm long, densely hairy, apex acute, margin entire. *Flowers* actinomorphic, 2–3 mm in diam.; pedicels up to 4 mm long, hairy; bracteole not seen. *Calyx* yellowish green, gamosepalous, campanulate, 5-lobed, hairy; tube ca 1 by 2 mm; lobes deltoid, ca 1 by 1 mm, apex acute, margin entire. *Corolla* yellowish green, free, petals 5, oblanceolate in outline, hooded, ca 1 by 0.5 mm, sparsely hairy, apex obtuse, margin entire, base claw. *Stamens* 5, free, ca 1 mm long, glabrous; anthers dorsifixed, 2-celled, ca 0.25 mm long, glabrous. *Disc* yellow, lobed, glabrous. *Ovary* superior but immersed in the disc, ca 1 mm in diam., glabrous, placentation axile, 2-loculed; style absent; stigma bilobed, each lobe ca 0.25 mm in diam., glabrous. *Fruit* a drupe, black, globose, 0.5–0.8 mm in diam., glabrous. *Seed* not seen.

**Thailand.**— Throughout Thailand.

**Distribution.**— Tropical Asia and Tropical Australia.

**Ecology.**— On open areas, old rice fields, roadsides, marsh soil and termite mounds. Flowering and fruiting all year round.

**Vernacular**— Ta-chu-mae (ตาจู้แม), Lai-Chu-mi (ไลจูมี) (Karen-Chiang Mai); Phutsa kho (พุทสาขอ), Let yiao (เล็ดเขี้ยว), Lep yiao (เลียบเขี้ยว) (Central); Ma tan kho (มะตันขอ), Nam lep yiao (หนามเลียบเขี้ยว), Mak nam (หมากหนาม)

(Northern); Yap yio (ยั้งยี่ว) (Peninsular); Sang khan (สังคันทน์) (Surat Thani, Ranong); Sang kham (สังขมา) (Nakhon si Thammarat).

**Specimens examined.**— *P. Pattarakulpisutti et al.* 180, 433 (PSU).

## RUBIACEAE

**59. *Canthium horridum*** Blume, Bijdr. Fl. Ned. Ind. 16: 966. 1826; Hook. f. in Fl. Br. Ind. (J. D. Hooker) 3: 135. 1880; Ridl., Fl. Malay. Penin. 2: 123. 1923.

Shrub, up to 1.5 m high; branches with pairs of straight thorns, sparsely hairy. **Leaves** simple, opposite; stipules interpetiolar, broadly deltoid, ca 3 by 2 mm long, hairy, apex obtuse, margin entire; petiole ca. 1 mm long, sparsely hairy; blade ovate, 8–20 by 5–15 mm, sub-coriaceous, hairy at veins, apex acute, margin entire, base obtuse. **Flowers** solitary, axillary, actinomorphic, ca 5 mm in diam.; peduncle up to 1 mm long, glabrous; bract not seen. **Calyx** green, gamosepalous, campanulate, 5-lobed, glabrous; tube ca 2 by 2 mm; lobes deltoid, ca 1 by 1 mm, apex acute, margin entire. **Corolla** yellowish green, gamopetalous, rotate, 5-lobed, villose at throat; tube ca 3 by 3 mm; lobes lanceolate, ca 3 by 1.5 mm, apex acute, margin entire. **Stamens** 5, free, epipetalous; filaments up to 1 mm long, glabrous; anther basifixed, 2-celled, ca 1 mm long, glabrous. **Ovary** inferior, ca 2 mm in diam., glabrous, placentation apical, 2-loculed; style 1, ca 3 mm long, glabrous; stigma 1, capitate, ca 1 mm in diam., glabrous. **Fruit** drupaceous, red, sub-globose to elliptic, 10 by 5–8 mm, glabrous. **Seed** not seen. **Plate 8.G.**

**Thailand.**— PENINSULAR: Trang, Songkhla.

**Distribution.**— Indochina, Peninsular Malaysia, Java, Borneo and Philippines.

**Ecology.**— Found on secondary thicket in seasonally flooded areas, on termite mounds in rice fields, open rock platforms. Flowering and fruiting all year round.

**Vernacular.**— Kae (แกะ), Khlet nu (เค็ล็ดหนู), Nam lep rok (หนามเล็บรอก) (Peninsular).

**Specimens examined.**— *P. Pattarakulpisutti et al.* 182, 243 (PSU).

**60. *Kailarsenia campanula*** (Ridl.) Tirveng., *Nordic J. Bot.* 3(4): 464. 1983.— *Gardenia campanula* Ridl., *Fl. Malay. Penin.* 2: 81. 1923.

Shrub, up to 2.5 m high; bark light brown with white blotches; flowering twigs 3–5 mm in diam., glabrous. **Leaves** simple, crowded on branch tip, opposite, often ternate; stipules interpetiolar, connate into a tube, 5–8 mm long, hairy, lobes narrowly to broadly deltoid, apex acuminate, margin entire; petiole 5–10 mm long, hairy; blade obovate-lanceolate, 5–12 by 3–6.4 cm, membranous, glabrous, apex acuminate, margin ciliolate, base cuneate. **Flowers** solitary, axillary, actinomorphic, 6–6.5 cm in diam. fragrant, peduncle up to 1.2 cm long, sparsely hairy; bract absent. **Calyx** dark green, gamosepalous, tubular, 5-lobed, persistent, glabrous; tube 11–15 by 4 mm; lobes narrowly deltoid, 4–6 by 1 mm, apex acute, margin ciliolate. **Corolla** white, gamopetalous, campanulate, 5-lobed, inside hairy at basal part; tube greenish white with 5-longitudinal dark-green ridges, 1.6–1.7 by 1.5–1.7 cm; lobes elliptic-lanceolate, 2.5–2.8 by 1.4–1.5 cm, apex acute, margin entire. **Stamens** 5, free, epipetalous; filaments very short, glabrous; anthers dorsifixed, 2-celled, 1.5–1.6 cm long, glabrous. **Ovary** inferior, ca 3 mm in diam., glabrous, placentation parietal, 1-loculed; style 1, ca 1 cm long, glabrous; stigma 1, club-shape, indistinctly 2-lobes, 17–18 by 3 mm, glabrous. **Fruit** a berry, green, ellipsoid, crowned by the calyx lobes, 1.5–1.7 by 0.8–1 cm, glabrous. **Seeds** not seen. **Plate 8.H.**

**Thailand.**— PENINSULAR: Surat Thani, Nahhon Si Thammarat, Trang, Pattalung.

**Distribution.**— Malay Peninsula.

**Ecology.**— Found only on seasonally flooded areas, uncommon. Flowering in August, fruiting from November to December.



**Vernacular.**— Phut nam (พุดน้ำ) (Peninsular).

**Specimens examined.**— *P. Pattarakulpisutti et al.* 198, 200, 211, 214, 399 (PSU).

**Remark.**— This species is considered to be rare and threatened species in Thailand according to Thailand red data: plants by Santisuk *et al.*, 2006 and a preliminary Threatened plants in Thailand by Pooma *et al.*, 2005.

### 61. *Meyna* sp.

Shrub, up to 3 m high; bark light brown with white blotches, glabrous; branches with pairs or ternate of straight thorns, glabrous. **Leaves** simple, opposite; stipules interpetiolar, broadly deltoid, 4–6 by 1 mm long, glabrous, apex subulate, margin entire; petiole 4–8 mm long, glabrous to hairy; blade ovate to broadly elliptic, 5–7.5 by 2–4.5 cm, chartaceous, glabrous to hairy, apex acuminate, margin entire, base obtuse. **Flowers** solitary, axillary, actinomorphic, ca 5 mm in diam.; pedicels up to 2 mm long, sparsely hairy; bracts lanceolate ovate, ca 1 by 1 mm, glabrous, apex acute, margin entire. **Calyx** green, gamosepalous, campanulate, 5-lobed, persistent, sparsely hairy; tube ca 2 by 2 mm; lobes deltoid, ca 1 by 1 mm, apex acute, margin entire. **Corolla** yellowish green, gamopetalous, rotate, 5-lobed, villose at throat; tube ca 2 by 2 mm; lobes deltoid, ca 3 by 2 mm, apex acuminate, margin entire. **Stamens** 5, free, epipetalous; filaments up to 1 mm long, glabrous; anthers basifixed, 2-celled, ca 0.5 mm, long, glabrous. **Ovary** inferior, ca 2 mm in diam., glabrous, placentation axile, 5-loculed; style 1, ca 2 mm long, glabrous; stigma 1, capitate, ca 1 mm in diam. **Fruit** a berry, green, subglobose, ca 1.5 by 1.3 cm, glabrous. **Seeds** not seen.

**Thailand.**— PENINSULAR: Trang.

**Distribution.**—

**Ecology.**— Found on secondary thicket in seasonally flooded areas. Flowering and fruiting all year round.

**Vernacular.**—

**Specimens examined.**— *P. Pattarakulpisutti et al.* 251, 500, 645 (PSU).

**Remark.**— No data for Thai and Southeast Asia flora. More literatures are needed to clarify its status.

**62. *Mitragyna diversifolia*** (Wall. ex G. Don) Havil., J. Linn. Soc., Bot. 33: 71. 1897.—*Stephegyne diversifolia* (Wall. ex G. Don) Hook. f. in Fl. Br. Ind. (J. D. Hooker) 3: 26. 1880.

Small tree, deciduous, up to 15 m high, dbh up to 20 cm; bark grey to light brown; flowering twigs 1–3 mm in diam., hairy. **Leaves** simple, opposite; stipules interpetiolar, caducous, obovate to elliptic, hairy at median keel, 8–10 by 5–7 mm, apex obtuse, margin entire; petiole 1–1.7 cm long, hairy; blade oblanceolate-elliptic to oblanceolate, 3.7–7 by 2.3–3 cm, coriaceous, hairy at nerves, apex sub-acute, margin entire, base truncate. **Inflorescences** terminal, consist of 3–7 globular heads in simple or compound cyme-like; heads 1.5–1.7 cm in diam., many-flowered, peduncle 3–10 mm long, sparsely hairy; young heads surrounded by leafy bracts, oblanceolate, 13–25 by 4–10 mm, hairy at nerves, apex obtuse, margin entire. **Flowers** actinomorphic, fragrant, 3–4 mm in diam.; bracteoles spatulate, 1.5–2 by 1 mm, glabrous, apex obtuse, margin entire. **Calyx** white, gamosepalous, tubular, 5-lobed, persistent, sparsely hairy; tube ca 2 by 1 mm; lobes indistinct. **Corolla** creamy white to pale orange, gamopetalous, tubular, 5-lobed, hairy at throat; tube ca 4 by 1 mm; lobes oblanceolate, ca 3 by 1 mm, apex obtuse, margin entire. **Stamens** 5, free, epipetalous; filaments ca 0.5 mm long, glabrous; anthers dorsifixed, 2-celled, ca 1 mm long, glabrous. **Ovary** inferior, ca 1 mm in diam., glabrous, placentation axile, 2-loculed; style 1, up to 1 cm, glabrous; stigma 1, exerted, cylindrical, ca 1 mm long, glabrous. **Fruitlets** capsular, ellipsoid, ca 5 by 1.5 mm, glabrous. **Fruiting head** 8–10 mm in diam. **Seeds** not seen. **Plate 9.A.**

**Thailand.**— NORTHERN: Chiang Mai, Chiang Rai Lamphun, Phitsanulok, Kamphaeng Phet, Nakhon Sawan; NORTH-EASTERN: Loei; EASTERN: Chaiyaphum; SOUTH-WESTERN: Ratchaburi; CENTRAL: Chai Nat,

Saraburi, Pathum Thani, Bangkok; SOUTH-EASTERN: Prachin Buri; PENINSULAR: Surat Thani, Nakhon Si Thammarat, Trang, Satun.

**Distribution.**— China, Indochina, Peninsular Malaysia, Java, Philippines.

**Ecology.**— Very common in old rice fields, termite mounds in rice fields and secondary vegetation of seasonally inundated plains, considered to be pioneer species of floodplain vegetation. Flowering from March to September, fruiting from March to January.

**Vernacular.**— Kra thom khi mu (กระทุ่มชี้หมู) (Northern); Kra thum dong (กระทุ่มดง) (Kanchanaburi); Kra thum na (กระทุ่มนา), Kra thum nam (กระทุ่มน้ำ) (Central); Ka-tum (กาตุม) (Khmer-Prachin Buri); Tam (ตำ) (Suai-Surin); Tum sae (ตุ่มแซะ), Tum noi (ตุ่มน้อย), Tum nam (ตุ่มน้ำ) (Northern); Thom phai (ถ่มพาย) (Loei); Thom khi mu (ถ่มชี้หมู) (Songkhla); Thom na (ถ่มนา) (Surat Thani); Thom noi (โถมน้อย) (Phetchabun).

**Specimens examined.**— *P. Pattarakulpisutti et al.* 231, 236 (PSU).

**63. *Morinda elliptica*** Ridl., J. Straits Branch Roy. Asiat. Soc. 79: 86. 1918; Ridl., Fl. Malay. Penin. 2: 118. 1923.

Small tree, up to 5 m high, dbh up to 15 cm; bark grey; branchlets quadrangular, glabrous. **Leaves** simple, opposite; stipules interpetiolar, broadly deltoid, glabrous, 2–5 by 3–5 mm, apex acuminate, margin entire; petiole 5–13 mm long, glabrous; blade narrowly elliptic to elliptic-oblong, chartaceous, glabrous, 10–18.5 by 3–6.5 mm, apex acute to acuminate, margin entire, base cuneate. **Inflorescences** axillary, head, oblong, 8–10 by 5 mm, peduncle 0.8–5 cm long, glabrous; bract absent. **Flowers** actinomorphic, fragrant, 4–5 mm in diam., sessile; bracteole absent. **Calyx** green, gamosepalous, urceolate, 4–5-lobed, glabrous; tube ca 1.5 by 2 mm; lobes indistinct. **Corolla** white, gamopetalous, salverform, 4–5-lobed, glabrous; tube 7–8 by 1 mm; lobes linear-oblong, 7–8 by 1.5 mm, apex obtuse, margin entire. **Stamens** 4–5, free, epipetalous; filaments up to 3 mm long, glabrous;

anthers dorsifixed, 2-celled, ca 5 mm long, glabrous. **Ovary** inferior, ca 2 mm in diam., glabrous, placentation axile, 2-loculed; style 1, 1.2–1.3 cm long, glabrous; stigma bilobed, exerted, ca 3 mm long, glabrous. **Fruit** and **Seed** not seen.

**Thailand.**— PENINSULAR: Ranong, Trang, Satun, Songkhla.

**Distribution.**— Peninsular Malaysia.

**Ecology.**— Very common tree in open places, secondary vegetations and forest edges. Flowering and fruiting all year round.

**Vernacular.**— Ka-mu-du (กะมูดู) (Malay-Narathiwat); Yo thuean (ยอเถื่อน) (Chumphon); Yo pa (ยอป่า) (Trang, Satun).

**Specimens examined.**— *P. Pattarakulpisutti et al.* 441,488 (PSU); *G. Congdon* 225 (PSU); *A. Tongseedam* 22 (PSU).

**64. *Nauclea orientalis* (L.) L., Sp. Pl. ed. 2: 243. 1762.**

Tree, up to 26 m high, dbh up to 40 cm; bark dark brown; flowering twigs 3–4 mm in diam., glabrous. **Leaves** simple, opposite; stipules interpetiolar, caducous, obovate-lanceolate, glabrous, 8–10 by 5–7 mm, apex obtuse, margin entire; petiole 2–2.5 cm long, glabrous; blade ovate, 6.5–14 by 4–9 cm, coriaceous, glabrous, apex obtuse, margin entire, base obtuse. **Inflorescences** terminal, globular head, 2.3–3 cm in diam., many-flowered, peduncle 7–10 mm long, sparsely hairy; young heads not surrounded by involucre-like stipules or bracts; bract not seen. **Flowers** actinomorphic, 2–3 mm in diam., flowers in the head connate by their ovaries, sessile; bracteole not seen. **Calyx** dark brown, free, sepals 4, persistent, clavate, 2–3 by 1 mm, hairy, apex obtuse, margin entire, base claw. **Corolla** pale orange, gamopetalous, tubular, 4-lobed, glabrous; tube 5–6 by 2 mm; lobes oblong, 2–3 by 1–1.5 mm, apex obtuse, margin entire. **Stamens** 4, free, epipetalous; filament very short; anthers dorsifixed, 2-celled, up to 1.5 mm long, glabrous. **Ovary** inferior, ca 1 mm in diam., glabrous, placentation axile, 2-loculed; style 1, 1.1–1.2 cm long, glabrous; stigma 1, exerted, ellipsoid, ca 2 mm long, glabrous. **Fruitlets** of a head united into an

indehiscent syncarp. *Syncarp* woody, brown, globose, 2–2.5 mm in diam. *Seed* not seen. **Plate 9.B.**

**Thailand.**— NORTHERN: Mae Hong Son, Chiang Mai, Phrae, Phitsanulok, Kamphaeng Phet, Phichit; NORTH-EASTERN: Khon Kaen; EASTERN: Chaiyaphum, Ubon Ratchathani; SOUTH-WESTERN: Uthai Thani, Kanchanaburi, Ratchaburi, Phetchaburi; SOUTH-EASTERN: Sa Kaeo, Chanthaburi; PENINSULAR: Trang, Satun.

**Distribution.**— Sri Lanka, Indochina, Malesia and northern Australia

**Ecology.**— On seasonally flooded areas, near the river channels. Flowering in August, fruiting from November to December.

**Vernacular.**— Kra thum khlong (กระทุ่มคลอง), Kra thum nam (กระทุ่มน้ำ) (Central, Peninsular); Ka-loe (กะเลอ), Se-sa-bo (เส้สะบอ) (Karen-Mae Hong Son); Kan lueang (ก้านเหลือง), Taku (ตะกู่), Sakae lueng (สะแกเหลือง) (Central); Tum khak (ตุ้มซัก), Tum kham (ตุ้มคำ) (Northern); Tum dong (ตุ้มดง) (Buri Ram, Lampang); Tum lueang (ตุ้มเหลือง) (Mae Hong Son); Po khi ma haeng (ปอจีหมาแห้ง) (Buri Ram).

**Specimens examined.**— *P. Pattarakulpisutti et al.* 441,488 (PSU).

**65. *Tamilnadia uliginosa*** (Retz.) Tirveng. & Sastre, Mauritius Inst. Bull. 8(4): 85. 1979.

Small tree, up to 4 m high, dbh up to 15 cm; bark light brown with white blotches; branches quadrangular, glabrous; short shoots decussately arranged, with 2–4 straight thorns and knob-like crowded on the tip, glabrous. *Leaves* simple, crowded on much contracted short shoot tip, opposite; stipules interpetiolar, deltoid, 2–4 by 2–3 mm long, glabrous, apex acuminate, margin entire; petiole 5–15 mm long, sparsely hairy; blade obovate to oblanceolate, 9–14 by 3–7 cm, sub-coriaceous, glabrous, apex sub-acute, margin entire, base attenuate. *Flowers* solitary, axillary, dimorphic, large and sessile bisexual or small and pedicellate-functionally staminate flowers, actinomorphic, fragrant, 4–4.3 cm in diam. in sessile flower and 3–3.5 in

pedicellate flower, peduncle 8–10 cm long in pedicellate flower and up to 3 mm in sessile flower, glabrous. **Calyx** dark green, gamosepalous, 5-lobed, persistent; tube urceolate, 12–13 by 8–9 mm in sessile flower and 5–8 by 10 mm in pedicellate flower, glabrous; lobes very short, ca 1 mm long, glabrous, apex obtuse, margin ciliolate. **Corolla** white, gamopetalous, rotate, 5-lobed; tube greenish white, ca 6 by 8 mm in sessile flower and 4 by 6 mm in pedicellate flower, glabrous outside, hairy inside; lobes orbicular, 1.8–2 by 2–2.2 cm in sessile flower and 1.3 by 1.3–1.4 cm in pedicellate flower, glabrous, apex obtuse, margin entire. **Stamens** 5, epipetalous; anthers sessile, dorsifixed, 2-celled, 7–11 mm long, glabrous. **Ovary** inferior, ca 3 mm in diam., glabrous, placentation axile, 2-loculed; style 1, 8–12 mm long, glabrous; stigma 1, club-shape, indistinctly 2-lobes, 5–8 by 4 mm, glabrous. **Fruit** a berry, dimorphic, obovate-ellipsoid, glabrous; the larger fruits produced from sessile flower 4.5–6.5 by 3.5–5 cm; the smaller fruits ca 2 by 2 cm. **Seeds** not seen. **Plate 9.C.**

**Thailand.**— Throughout Thailand.

**Distribution.**— India, Sri Lanka, Indochina.

**Ecology.**— Scattering in semi-evergreen rain forests, sometime found in secondary vegetation in seasonally flooded areas, In Thailand, the species is rather rare. Flowering and fruiting all year round.

**Vernacular.**— Kralam phuk (กระลำพูก), Talum phuk (ตะลุมพูก), Ma khang khao (มะคังขาว) (Central, Southwestern); Mok nam khao (มอกน้ำข้าว), Ma khao (มะข้าว) (Northern); Ma khang (มะคัง) (Uttaradit); Lup puk (ลูบปูก) (Northeastern); Lum phuk (ลุมพูก) (Lop buri).

**Specimens examined.**— *P. Pattarakulpisutti et al.* 191, 245 (PSU).

## SAPINDACEAE

**66. *Allophylus cobbe*** (L.) Raeusch., Nomencl. Bot. (Raeusch.) 108. 1797; Yap in Tree Fl. Mal. 4: 436. 1989; Welzen in Fl. Thailand. 7(1): 176, fig. 4. 1999.

Shrub, up to 4 m high; bark brownish grey; young branches densely hairy; monoecious. **Leaves** trifoliate, alternate; petiole 2.5–8 cm long, hairy; petiolules 2–7 mm long, densely hairy; leaflets lanceolate-ovate to elliptic, 5–14.5 by 3–6.5 cm, sub-membranous, hairy only at veins, apex acuminate to cuspidate, margin serrulate, base obtuse to cuneate. **Inflorescences** axillary, raceme; peduncle 3–6 cm long, hairy, rachis 2.8–11 cm long, hairy; bract not seen. **Flowers** unisexual, actinomorphic; calyx free, sepals 4, sparsely hairy; corolla free, petals 4, with two small scales inside, pilose inside; bracteoles narrowly deltoid, ca 0.5 by 0.25 mm, hairy, apex acute, margin entire. **Staminate flowers** up to 2 mm in diam.; pedicels up to 2 mm long, sparsely hairy; sepals greenish white, outer ones broadly deltoid, ca 1 by 1 mm, apex obtuse, margin ciliolate, inner ones orbicular, ca 1.5 by 1.5 mm, apex obtuse, margin ciliolate; disc 4-lobed, glabrous; petals greenish white, spatulate, ca 1.5 by 0.5 cm, apex obtuse, margin entire, base clawed; stamens 8, free, filaments up to 2 mm long, hairy on lower part, anthers dorsifixed, 2-celled, ca 0.5 mm long, glabrous. **Pistillate flowers** up to 2 mm in diam.; pedicels up to 2 mm long, sparsely hairy; sepals and petals as in staminate ones; disc 4-lobed, glabrous; stamens 8, free, filaments up to 1 mm long, hairy on lower part, anthers as in staminate one; ovary superior, ca 1 mm in diam., 2-lobed, hairy, placentation axile, 2-loculed, stigma 2, filiform, 0.5–0.75 mm long, glabrous. **Fruit** and **Seed** not seen. **Plate 9.D.**

**Thailand.**— NORTH-EASTERN: Udon Thani; EASTERN: Nakhon Ratchasima; SOUTH-WESTERN: Uthai Thani, Kanchanaburi, Prachuap Khili Khan; SOUTH-EASTERN: Chon Buri; PENINSULAR: Surat Thani, Trang.

**Distribution.**— Pantropics.

**Ecology.**— Usually in marsh soils, secondary vegetations or the edge of seasonally flooded areas. Flowering from May to June, fruiting from June to July.

**Vernacular.**— Tosai khao (ต๋อใ้ขาว) (Peninsular).

**Specimens examined.**— *P. Pattarakulpisutti et al.* 285, 338, 363, 377 (PSU).

**67. *Lepisanthes rubiginosa*** (Roxb.) Leenh., *Blumea* 17(1): 82. 1969; Yap in *Tree Fl. Mal.* 4: 446. 1989; Welzen in *Fl. Thailand.* 8(2): 214, pl. VII3. 1999.

Shrub to small tree, up to 8 m high, dbh 10–15 cm; bark grey, smooth; flowering twigs up to 6 mm in diam., glabrous; dioecious. **Leaves** paripinnate, alternate; petiole 7–10 cm long, glabrous; rachis 2.5–4 cm long, glabrous, petiolules swollen, 7–10 mm long, glabrous; leaflets 4–6, elliptic-oblongate to elliptic, 8–18 by 4–7.5 cm, sub-coriaceous, glabrous, apex sub-acute, margin entire, base cuneate. **Inflorescences** ramiflorous and axillary, thyrus; peduncle very short, densely hairy; rachis 14–25 cm, long, densely hairy, bract not seen. **Flowers** unisexual, zygomorphic; calyx free, sepals 4–5, densely hairy; corolla free, petals 4, with hairy scale inside, pilose outside; bracteoles deltoid, ca 0.5 by 0.5 mm, densely hairy, apex acute, margin entire. **Staminate flowers** up to 6 mm in diam.; pedicels up to 5 mm long, densely hairy; sepals light green, outer ones orbicular, 3 by 2–4 mm, apex obtuse, margin entire, inner ones ovate, 4–5 by 2–3 mm, apex obtuse, margin entire; disc a long rim, glabrous; petals white, oblongate in outline, ca 6 by 2 mm, glabrous, apex obtuse, margin entire, base clawed; scale with two apical clavate crests, ca 3 mm long, pilose; stamens 8, free, filaments up to 6 mm long, anthers dorsifixed, 2-celled, ca 1 mm long, glabrous. **Pistillate flowers** not seen. **Fruit** and **Seed** not seen.

**Thailand.**— NORTHERN: Chiang Mai, Chiang Rai, Lampang, Phrae, Sukhothai; NORTH-EASTERN: Phetchabun, Loei, Khon Kaen; EASTERN: Nakhon Ratchasima, Surin, Ubon Ratchathani; SOUTH-WESTERN: Kanchanaburi, Prachuap Khiri Khan; CENTRAL: Saraburi, Nakhon Nayok, Nakhon Pathom, Bangkok, Samut Prakan; SOUTH-EASTERN: Prachin Buri, Chon Buri, Rayong, Chanthaburi, Trat; PENINSULAR: Chumphon, Surat Thani, Phangnga, Krabi, Nakhon Si Thammarat, Trang, Satun, Songkhla, Yala.

**Distribution.**— Southern and South-Eastern India to South-Eastern China, Indochina, Malesia to Northern Australia.



**Ecology.**— On secondary vegetations in old rice fields. Flowering from November to April, fruiting from October to April.

**Vernacular.**— Ma huat (มะหวด), Sam (ซำ) (General); Huat lao (หวดลาว), Si hok noi (สี่หอกน้อย) (Northern); Huat kha (หวดคา), Ma huat pa (มะหวดป่า) (North-eastern); Chanlu (ชันรุ้), Huat kha (หวดคา), Ma huat bat (มะหวดบาท), Ma huat ling (มะหวดลิง) (South-eastern); Kasam (กะซำ), Kamcham (กำจำ), Kansam (กำซำ), Ma cham (มะจำ), Mai khamcham (ไม้กำจำ), Nam sam (นำซำ) (Peninsular).

**Specimen examined.**— *P. Pattarakulpisutti et al.* 191 (PSU).

### SCROPHULARIACEAE

**68. *Limnophila erecta*** Benth., Prodr. (DC.) 10: 388. 1846; Ridl., Fl. Malay. Penin. 2: 476. 1923.

Annual herb, ca 10 cm high; stem erect and prostrate, glabrous. **Leaves** simple, decussate, sessile; blade broadly elliptic to elliptic, 7–15 by 3–5 mm, chartaceous, punctate, apex acute, margin serrulate, base cuneate to obtuse. **Flowers** solitary, axillary, zygomorphic, ca 3 mm in diam.; peduncle ca 5 mm long, glabrous; bracts filiform, ca 2 mm long, glabrous, apex acute, margin entire. **Calyx** green, gamosepalous, tubular, 5-lobed, glabrous; tube ca 1.5 by 1.5 mm; lobes linear-lanceolate, 3–4 by 0.75–1 mm, apex acuminate, margin entire. **Corolla** white, gamopetalous, bilabiate, 2-lobed, villose inside; tube ca 4 by 2 mm; upper lip oblong, ca 1.5 by 1.5 mm, apex truncate, margin entire; lower lip 3-lobed, each lobe orbicular in outline, 1.5–2 by 1.5–2 mm, apex truncate, margin entire. **Stamens** 4, free, epipetalous, didynamous; posterior filaments ca 1.5 mm long, glabrous; anterior filament ca 2.5 mm long, glabrous; anthers basifixed, 2-celled, ca 0.5 mm long, glabrous. **Ovary** superior, ca 0.5–0.7 mm in diam., glabrous, placentation axile, 2-loculed; style 1, ca 2 mm long, glabrous; stigma bilobed, flattened, each lobe ca 0.5 by 0.25 mm, glabrous. **Fruit** a capsule, septifragal dehiscent, ovoid, ca 3 by 2 mm, glabrous. **Seeds** oblong, ca 0.25 by 0.1 mm, surface papillose.

**Thailand.**— PENINSULAR: Trang.

**Distribution.**— Myanmar, Malesia, Vietnam and Southern China.

**Ecology.**— In rice fields. Flowering and fruiting all year round.

**Vernacular.**—

**Specimen examined.**— *P. Pattarakulpisutti et al.* 411 (PSU).

**69. *Limnophila laxa*** Benth., Prodr. (DC.) 10: 388. 1846; T. Yamaz., in Fl. Thailand. 5(2): 168. 1987.

Annual herb, 9–14 cm high; stem erect and prostrate, sparsely hairy. *Leaves* simple, decussate; sessile; blade narrowly elliptic, 12–20 by 3–7 mm, subcoriaceous, sparsely hairy and punctate, apex acute, margin serrulate, base cuneate to obtuse. *Flowers* solitary, axillary, zygomorphic, 4–5 mm in diam.; peduncle 3–5 mm long, hairy; bracts filiform, ca 2 mm long, hairy, apex acute, margin entire. *Calyx* green, gamosepalous, tubular, 5-lobed, sparsely hairy and punctate outside; tube 1–2 by 2 mm; lobes linear-lanceolate, 2–2.5 by 0.5 mm, apex acuminate, margin entire. *Corolla* violet with white blotches on upper lip, gamopetalous, bilabiate, 2-lobed, villose inside; tube 5–6 by 2 mm; upper lip reniform in outline, 2–3 by 4 mm, apex shallowly bilobed to truncate, margin entire; lower lip 3-lobed, each lobe reniform in outline, ca 2 by 3 mm, apex obtuse, margin entire. *Stamens* 4, free, epipetalous, didynamous; posterior filaments ca 2 mm long, glabrous; anterior filament ca 3 mm long, glabrous; anthers basifixed, 2-celled, ca 1 mm long, glabrous. *Ovary* superior, ca 2 mm in diam., glabrous, placentation axile, 2-loculed; style 1, 3.5–4 mm long, glabrous; stigma bilobed, flattened, each lobe ca 0.5 by 0.25 mm, glabrous. *Fruit* a capsule, septifragal dehiscent, ellipsoid, ca 4 by 2 mm, glabrous. *Seeds* not seen. *Plate* 9.E.

**Thailand.**— PENINSULAR: Chumphon, Ranong, Surat Thani, Trang, Phatthalung, Narathiwat.

**Distribution.**— Sri Lanka, Vietnam, Myanmar, Peninsular Malaysia, Sumatra and Borneo.

**Ecology.**— Scattering in low abundance on marshy areas, rice fields and waysides. Flowering and fruiting all year round.

**Vernacular.**— Nang raksa (นางรักษา) (General).

**Specimens examined.**— *P. Pattarakulpisutti et al.* 372, 507 (PSU).

**70. *Lindernia ciliata*** (Colsm.) Pennell, *Brittonia* 2. 182. 1936; T. Yamaz., in Fl. Thailand. 5(2): 200, fig. 48.11–13. 1987.

Annual herb, 7–10 cm high; stem erect and prostrate, 4-angled, glabrescent. **Leaves** simple, decussate; sessile; blade lanceolate oblong to lanceolate, 11–24 by 2–5 mm, chartaceous, glabrous, apex obtuse, margin sharply serrate with aristate teeth, obtuse. **Inflorescences** terminal, raceme, usually 7–10-flowered; peduncle 8–25 mm long, glabrous; rachis 2–3 cm long, glabrous; bracts lanceolate, 3–4 by 1 mm, glabrous, apex acuminate, margin serrate, glabrous. **Flowers** axillary, zygomorphic, ca 2 mm in diam.; pedicels 2–3 mm long, glabrous; bracteoles lanceolate, 3–4 by 1 mm, glabrous, apex acuminate, margin serrate, glabrous. **Calyx** light green, gamosepalous, tubular, 5-lobed, glabrous; tube 1–1.5 by 1 mm; lobes filiform, up to 3 mm long, apex acute, margin entire. **Corolla** pale purple with red spots at lower lip, gamopetalous, bilabiate, 2-lobed, glabrous; tube 3–4 by 1 mm; upper lip oblong, ca 2 by 1 mm, apex shallowly emarginate, margin entire; lower lip 3-lobed, unequal, medial lobe reniform in outline, ca 2 by 1 mm, apex truncate, margin entire, lateral lobes obliquely ovate in outline, ca 2 by 1 mm, apex obtuse, margin entire. **Stamens** 2, free, epipetalous; filaments ca 1 mm long, glabrous; anthers basifixed, 2-celled, ca 0.5 mm long, glabrous. **Ovary** superior, ca 0.25 mm in diam., glabrous, placentation axile, 2-loculed; style 1, 4–5 mm long, glabrous; stigma bilobed, flattened, each lobe ca 0.25 by 0.5 mm glabrous. **Fruit** a capsule, septicidal dehiscent, linear, 7–10 by 0.5 mm, glabrous. **Seeds** ellipsoid, ca 0.25 by 0.25 mm, surface pitted.

**Thailand.**— Throughout Thailand.

**Distribution.**— India, Nepal, Sri Lanka, Myanmar, Southern China, Ryukyu, Indochina, Malesia, Australia and New Guinea.

**Ecology.**— Scattering in low abundance on marshy areas and rice fields. Flowering and fruiting all year round.

**Vernacular.**— Ngiang pla (เงี้ยวปลา) (Northern); Phak kat phu (ผักกาดภู), Phak i hae (ผักอีแฮ) (Northeastern); Ya karon (หญ้ากะระร่อน) (Central); phak hom ho pa (ผักหอมฮ้อป่า) (Southeastern).

**Specimen examined.**— *P. Pattarakulpisutti et al.* 435 (PSU).

**71. *Lindernia crustacea*** (L.) F. Muell., Syst. Census Austral. Pl. 1: 97. 1882; T. Yamaz., in Fl. Thailand. 5(2): 168, fig. 48.9–10. 1987.

Annual herb, 4–6.5 cm high; stem erect and prostrate, sparsely hairy. **Leaves** simple, decussate; stipule absent; sessile; blade ovate, 5–12 by 3–7 mm, subcoriaceous, punctate, apex acute, margin serrate, base cuneate. **Flowers** solitary, axillary, zygomorphic, 4–5 mm in diam.; peduncle 2–10 mm long, sparsely hairy; bract absent. **Calyx** green and purple at apex, gamosepalous, tubular, 5-lobed, sparsely hairy outside; tube 3.5–4 by 1–1.5 mm; lobes narrowly deltoid, ca 1 by 0.5 mm, apex acuminate, margin entire. **Corolla** violet with white blotch at apex, gamopetalous, bilabiate, 2-lobed, glabrescent outside; tube 4–5 by 1 mm; upper lip deltoid in outline, ca 3 by 2 mm, apex shallowly bilobed, margin crenulate; lower lip 3-lobed, each lobe orbicular, ca 2 by 1 mm, apex obtuse, margin crenulate. **Stamens** 4, free, epipetalous, didynamous; posterior filaments ca 3 mm long, glabrous, with filiform projection at base; projection 0.5–1 mm long, glabrous; anterior filaments ca 1 mm long, glabrous; anthers basifixed, 2-celled, ca 0.75 mm long, glabrous. **Ovary** superior, ca 0.5 mm in diam., glabrous, placentation axile, 2-loculed; style 1, 4–5 mm long, glabrous; stigma bilobed, flattened, each lobed ca 1 by 0.5 mm, hairy. **Fruit** a capsule, septical dehiscence, ellipsoid to broadly ellipsoid, 3–4 by 2–3 mm, glabrous. **Seeds** not seen.

**Thailand.**— Throughout Thailand.

**Distribution.**— India, Nepal, Sri Lanka, Myanmar, China, Indochina, Malesia, Australia, Micronesia and Polynesia.

**Ecology.**— Very common in marshy areas, rice fields and waysides. Flowering and fruiting all year round.

**Vernacular.**— Ya kap hoi tua mia (หญ้ากาบหอยตัวเมีย) (Peninsular).

**Specimen examined.**— *P. Pattarakulpisutti et al.* 434 (PSU).

### STYLIDACEAE

**72. *Stylidium tenellum*** Sw. ex Willd., Sp. Pl., ed. 4 (Willdenow) 4(1): 146. 1805; C. B. Clarke in Fl. Brit. India (J. D. Hooker) 3: 420. 1881; K. Larsen in Fl. Thailand 2(3): 274, fig. 45a-b. 1975.

Annual herb, 7.5–12 cm high; stems erect, glabrous. **Leaves** simple, spiral, sessile; blade elliptic to narrowly elliptic, 5 by 1–2 mm, sub-membranous, glabrous, apex obtuse, margin entire, base obtuse. **Inflorescences** terminal, thyrse, usually 3–7-flowered; peduncle 1–1.5 cm long, glabrous; rachis ca 5 mm long, glabrous; bracts leaf-liked, linear-oblong, 3–4 by 1 mm, glabrous, apex obtuse, margin entire, glabrous. **Flowers** zygomorphic, ca 2 mm in diam.; pedicels 3–11 mm long, glabrous; bracteoles linear-oblong, 3–4 by 1 mm, glabrous, apex obtuse, margin entire, glabrous. **Calyx** green with pink blotch at apex, gamosepalous, bilabiate, 2-lipped, covered with glandular hairs outside; tube ca 0.5 by 0.5 mm; upper lip oblong, 1.5–2 by 1–1.5 mm, apex bilobed, margin entire; lower lip 3-lobed, each lobe lanceolate-oblong, 1.5–2 by 1.5 mm, apex obtuse, margin entire. **Corolla** pink, gamopetalous, bilabiate, 5-lobed, covered with glandular hairs outside; tube ca 1 by 0.5 mm, with a row of minute appendages inside; upper lobe ovate-lanceolate, ca 1 by 0.25 mm, apex cuspidate, margin entire; lateral lobes oblong, ca 1 by 0.5 mm, apex truncate, margin entire; lower lobes oblong in outline, ca 2 by 1.5 mm, apex bilobed, margin entire. **Stamens** 2, filaments and style fused into column, ca 4 mm long, glabrous; anthers extrorse, 2-celled, ca 0.5 mm long, glabrous. **Ovary** inferior, ca 0.5

mm in diam., glabrous, placentation axile, 2-loculed; stigma 1, capitate, ca 1 mm in diam., hairy. *Fruit* and *Seed* not seen. *Plate 9.F.*

**Thailand.**— SOUTH-EASTERN: Rayong, Prachin Buri; PENINSULAR: Surat Thani, Trang, Satun, Songkhla.

**Distribution.**— India, Myanmar, Cambodia, Vietnam, Peninsular Malaysia and Sumatra.

**Ecology.**— In marshy areas, rice fields and waysides. Flowering and fruiting all year round.

**Vernacular.**— Ya tom (หญ้าต๋อม) (Southeastern).

**Specimen examined.**— *P. Pattarakulpisutti et al.* 453 (PSU).

## VITACEAE

**73. *Leea indica*** (Burm. f.) Merr., Philipp. J. Sci. 14 (2): 245. 1919; Ridsdale in Fl. Males., Ser. 1, Spermat. 7(4): 779, fig. 23. 1975; Z. D. Chen & J. Wen, in Flora of China 12: 169. 2007; Welzen. in Fl. Thailand. 10(2): 221, fig. 5b&6. 2010.— *L. sambucina* (L.) Willd., M. A. Lawson in Fl. Brit. India (J. D. Hooker) 1:666. 1875; Ridl., Fl. Malay. Penin. 1: 484, fig. 48. 1922; Backer & Bakh. f., Fl. Java (Spermatoph.) 2: 94. 1965.— *L. gigantea* Griff., Ridl., Fl. Malay. Penin. 1: 484. 1922.

Shrub, up to 5 m high, dbh up to 3 cm; bark green to light-brown; branchlets 5–6 mm in diam., glabrous. *Leaves* bipinnate, alternate; stipules caducous, obovate, 1.5–3.7 by 1.1–1.6 cm, glabrous, apex obtuse, margin entire; petiole 12–17.5 cm long, glabrous; rachis 16.7–25.5 cm long, glabrous; petiolules 5–7 mm long, glabrous; leaflets 17–35, lanceolate-oblong to linear-oblong rarely lanceolate, 4.5–17 by 2.3–4.8 cm, chartaceous, glabrous, apex acuminate, margin serrate, base obtuse. *Inflorescences* opposite to leaves, compound dichasial, many flowered; peduncle 5.5–13.3 cm long, glabrous to sparsely hairy; bract not seen. *Flowers* actinomorphic, 3–4 mm in diam.; pedicels up to 1 mm long, glabrous to sparsely hairy; bracteoles deltoid, ca 1 by 1 mm, sparsely hairy, apex acute, margin entire. *Calyx* green, gamosepalous,

campanulate, 5-lobed, glabrous; tube ca 2 by 2 mm; lobes broadly deltoid, ca 0.5 by 1 mm, apex acute, margin entire. **Corolla** greenish white, gamopetalous, campanulate, 5-lobed; glabrous; tube ca 3 by 2 mm; lobes oblong, ca 3 by 2 mm, apex acute, margin entire. **Stamens** 5, connate into staminodal tube, ca 2 mm long, apex of staminodal tube 5-lobed, connate to each other by thinner tissue to form sinuses, apex of lobed retuse; filaments ca 1 mm long, glabrous; anthers dorsifixed, 2-celled, ca 1.5 mm long, glabrous. **Ovary** superior, ca 1 mm in diam., glabrous, placentation axile, 6-loculed; style 1, 1.5–2 mm long, glabrous; stigma 1, capitate, ca 0.1 mm in diam., glabrous. **Fruit** a capsule, green, depressed-subglobose, 3–4 by 3–6 mm, lobed, glabrous. **Seeds** reddish brown, crescent, trigonous, ca 3 by 1 mm. **Plate 9.G.**

**Thailand.**— Throughout Thailand.

**Distribution.**— Sri Lanka, India, Nepal, Bangladesh, Indochina, Andaman and Nicobar island, Malesia, Northern Australia, Solomon island, Santa Cruz Island, New Hebrides and Fiji.

**Ecology.**— Open thickets along riverbeds and along water courses in semi-evergreen rain forests. Flowering and Fruiting throughout year.

**Vernacular.**— Katang bai (กะตังใบ) (Bangkok, Chanthaburi, Chaing Mai); Kha nang bai (กะนางใบ) (Trat); Chang khoeng (ช้างเขิง) (Shan); Dang wai (ดังหวาย) (Narathiwat); Tong chuam (ตองจัวม), Tong tom (ตองต้อม) (Northern); Bangbai ton (บางใบต้น) (Trang).

**Specimens examined.**— *P. Pattarakulpisutti et al.* 359, 398 (PSU).

**74. *Leea rubra*** Blume ex Spreng, Syst. Veg. 1: 670. 1824; Ridl., Fl. Malay. Penin. 1: 485. 1922; Corner, Wayside Tree of Malaya 1: 97. 1940; Backer & Bakh. f., Fl. Java (Spermatoph.) 2: 94. 1965; Welzen. in Fl. Thailand. 10(2): 225, fig. 3h-i, 4d-e & 5c. 2010.

Semi-herbaceous shrub, up to 2.5 m high, dbh up to 1.5 cm; bark green to light-brown; branchlets 2–3 mm in diam., glabrous. **Leaves** bipinnate to tripinnate,

alternate; stipules caducous, narrow wing, 1.5–4.7 by 0.4–0.5 cm, glabrous, apex obtuse, margin entire; petiole 6.8–10.5 cm long, glabrous; rachis 17.8–20 cm long, glabrous; petiolules 1–3 mm long, glabrous; leaflets 29–51, lanceolate, linear-lanceolate to elliptic, 3.5–9.7 by 1.8–3.5 cm, chartaceous, glabrous, apex caudate-acuminate, margin serrate, base obtuse to cuneate. **Inflorescences** opposite to leaves, compound dichasial, many flowered; peduncle 8–11.5 cm long, bracts indistinct. **Flowers** actinomorphic, 2–3 mm in diam.; pedicels up to 2 mm long, sparsely hairy; bracteoles deltoid, ca 1 by 1 mm, apex acute, margin with teeth. **Calyx** red, gamosepalous, campanulate, 5-lobed, glabrous; tube ca 2 by 2 mm; lobes deltoid to broadly deltoid, 1 by 0.5–1 mm, apex acute, margin entire. **Corolla** red, gamopetalous, urceolate, 5-lobed glabrous; tube ca 2 by 1.5 mm; lobes lanceolate-oblong, ca 1 by 1.5 mm, apex acute, margin entire. **Stamens** 5, connate into staminodal tube, ca 1 mm long, apex of staminodal tube 5-lobed, connate to each other by thinner tissue to form sinuses, apex of lobed retuse; filaments ca. 1 mm long; anthers dorsifixed, 2-celled, ca 1 mm long, glabrous. **Ovary** superior, ca 1 mm in diam., glabrous, placentation axile, 6-loculed; style 1, glabrous; stigma 1, capitate, ca 0.1 mm in diam., glabrous. **Fruit** a capsule, reddish pink, depressed-subglobose, 2–3 by 5–6 mm, lobed, glabrous. **Seeds** crescent, trigonous, ca 3 by 1 mm. **Plate 9.H.**

**Thailand.**— NORTHERN: Tak; NORTH-EASTERN: Nong Khai; EASTERN: Buri Ram, Surin; South-western: Kanchanaburi; CENTRAL: Nahkon Pathom; SOUTH-EASTERN: Trat; PENINSULAR: Surat Thani, Satun, Trang, Songkhla; Narathiwat.

**Distribution.**— India, Bangladesh, Indochina, Malesia and Northern Australia.

**Ecology.**— Very common along streams, roadsides, old rice fields, marshy area and fresh water swamp forests. Flowering and fruiting all year round.

**Vernacular.**— Katang bai daeng (กะตังใบ) (Bangkok); Khueng (เหียง) (Central).



**Specimens examined.**— *P. Pattarakulpisutti et al.* 166, 269, 349 (PSU).

## **MAGNOLIIDS**

### **ANNONACEAE**

**75. *Uvaria rufa*** Blume, Fl. Javae Anon., 19. 1830; P.T. Li & M.G. Gilbert in Flora of China 19: 169. 2011.

Woody climber; flowering twig 2–3 mm in diam., covered with stellate hairs. **Leaves** simple, distichous; stipule absent; petiole 3–5 mm long, covered with stellate hairs; blade oblong, elliptic to oblanceolate-oblong, 7–14 by 3.5–5.8 cm, subcoriaceous, lower surface densely covered with stellate hairs, upper surface sparsely covered with stellate hairs, apex acuminate to emarginate, margin entire, base truncate. **Inflorescences** axillary, cyme, 1–2-flowered; peduncle up to 3 mm long, covered with stellate hairs. **Flowers** actinomorphic, 1.7–2.5 mm in diam.; pedicels 7–13 mm long, covered with stellate hairs; bracts caducous, elliptic, ca 7 by 3 mm, covered with stellate hairs, apex acute, margin entire. **Calyx** brownish green, gamosepalous, campanulate, 3-lobed, covered with stellate hairs; tube 1 by 6–9 mm; lobes deltoid, 2–3 by 3–6 mm, apex sub-acute, margin entire. **Corolla** dark red, free, petals 6, oblong to obovate-oblong, 12–13 by 4–6 mm, sparsely hairy, apex obtuse, margin entire. **Stamens** numerous, free; filaments oblong, flattened, 3–4 by 1 mm, glabrous; anthers along filaments, introrsed, 2-celled, 2.5–3 mm long. **Ovary** superior, many free capels, ca 5 mm in diam., hairy at apex, placentation marginal; style 1, ca 3 mm long; stigma 1, capitate, ca 0.5 mm in diam., glabrous. **Fruits** aggregate; fruitlet a berry, red, ellipsoid to sub-globose, 2.5–4 by 1.7–2.4 cm, covered with stellate hairs. **Seeds** brown, oblong, flattened, ca 4 by 3 mm, glabrous. **Plate 10.A.**

**Thailand.**— Throughout Thailand.

**Distribution.**— Andaman islands, Myanmar, Southern China, Indochina and Malesia.

**Ecology.**— Climbing on the edges of semi-evergreen forests and thickets on termite mounds. Flowering from April to November, fruiting from May to December.

**Vernacular.**— Ting tang (ติงตัง) (Nakhon Ratchasima); Tin tang khrua (ติงตังเครือ) (Si sa ket, Ubon Ratchathani); Nom khwai (นมความ) (General); Nom maeo (นมแมว) (Central); Nom maeo pa (นมแมวป่า) (Chiang mai); Nom wua (นมวัว) (Krabi, Phitsanulok); Bu nga yai (บุหงายใหญ่) (Northern); Phi phuan (พีพวน) (Udon Thani); Phi phuan noi (พีพวนน้อย) (Chumphon); Si muan (สีม่วง) (Chaiyaphum); Ham ling (หำลิง) (Northeastern).

**Specimens examined.**— *P. Pattarakulpisutti et al.* 262, 345, 356, 371, 455 (PSU).

## **MONOCOTS**

### **AMARYLLIDACEAE**

**76. *Crinum amoenum*** Roxb., Hort. Bengal. (23); Fl. Ind. 2. 127; Hook. f. in Fl. Brit. India (J. D. Hooker) 6: 282. 1892.

Perennial herb with erect tufted of leaves, up to 60 cm high; bulb sub-globose, ca 5 by 6 cm, glabrous. **Leaves** simple, basal, linear-oblong, 30–55 by 1.5–3 cm, fleshy, glabrous, apex sub-acute, margin entire. **Inflorescences** basal, umbel, 6–12-flowered; scape 30–40 cm long, glabrous; involucral bracts scarious, narrowly deltoid, ca 5 by 1 cm, glabrous, apex acuminate, margin entire. **Flowers** actinomorphic, up to 15 cm in diam., sessile. **Perianth** white with green in throat, connate, salverform, 6-lobed, glabrous; tube 12.5–13 by 0.3 cm; lobes narrow-oblong to linear-oblong, 6.5–8 by 1 cm, glabrous, apex caudate-acuminate, margin entire. **Stamens** 6, free, epipetalous; filaments ca 5 cm long, glabrous; anthers versatile, 2-celled, 1–1.3 cm long, glabrous. **Ovary** inferior, ca 5 mm in diam., glabrous, placentation axile, 3-loculed; style 1, 17.5–18 cm long, glabrous; stigma 1, irregular, ca 1 mm in diam., glabrous. **Fruit** a capsule, sub-globose, pinkish white when mature, up to 3 by 3 cm, glabrous. **Seeds** not seen.

**Thailand.**— Central, Southeastern and Peninsular.

**Distribution.**— From Nepal to Myanmar.

**Ecology.**— Scattering on wet-open places, old rice fields and seasonally inundated areas. Survive dry period as bulb below ground. Flowering and fruiting from April to May.

**Vernacular.**— Krathium chang (กระเทียมช้าง) Bangkok.

**Specimens examined.** — *P. Pattarakulpisutti et al.* 184, 271 (PSU).

## ARACEAE

**77. *Cryptocoryne ciliata*** (Roxb.) Fisch. ex Wydler, *Linnaea* 5: 428. 1830; Ridl., Fl. Malay. Penin. 5: 86. 1967.

Rhizomatous herb with erect tuft of leaves, up to 1 m high; monoecious. *Leaves* simple, basal; petiole sheathing at lower part; 50–63 cm long; blade elliptic, 27–36 by 7–9 cm, fleshy, glabrous, apex obtuse, margin entire, base obtuse. *Spadix* basal, ca 15 cm long; lower portion cylindrical, ca 2 by 2 mm, composed of 5–7 pistillate flowers; central portion neuter, ca 7 by 1 mm, glabrous; upper portion ellipsoid, ca 5 by 2 mm, composed of many staminate flowers; appendix conic, 1 mm long; scape very short; spathe 30–31.5 cm long; lower part white, tubular, 23–25 by 0.5–0.7 cm, glabrous; limb maroon red, lanceolate, 6.5–7 by 1.7–2 cm, apex acuminate, margin fimbriate. *Flowers* unisexual, actinomorphic, sessile; perianth absent. *Staminate flowers* ca 1 mm in diam.; stamen 1; anther sessile, 2-celled, up to 0.5 mm long, glabrous. *Pistillate flowers* 2.5–3 mm in diam.; ovary superior, 2.5–3 by 1 mm, glabrous, placentation marginal, 1-locular; stigma 1, capitate, sessile, ca 0.1 mm in diam., hairy. *Fruit* a capsule, dark red, sub-globose, ca 3 by 3 cm, glabrous. *Seeds* not seen. *Plate 10.C.*

**Thailand.**— CENTRAL: Bangkok; PENNINSULAR: Trang.

**Distribution.**— India, Peninsular Malaysia, Borneo and Java.

**Ecology.**— In tidal mud along rivers. Flowering and fruiting all year round.

**Vernacular.**— Bai phai (ใบพาย) (Central); Phai (พาย) (Bangkok).

**Specimen examined.**—*P. Pattarakulpisutti et al.* 247 (PSU).

**78. *Typhonium flagelliforme*** (Lodd.) Blume, Rumphia 1: 134. 1837; Li Heng *et al.* in Fl. China. 23: 34. 2010.

Tuberous herb with erect tuft of leaves, 30–40 cm high; monoecious. **Leaves** simple, basal; petiole sheathing at lower part; 20–30 cm long; blade hastate to linear, 15–23 by 1.2–2 cm, membranous, glabrous, apex acute, margin entire, base hastate. **Spadix** basal, ca 1.2–1.3 cm long; lower portion cylindrical, 4–5 by 3 mm, composed of many pistillate flowers; central portion sterile, ca 2 by 0.1 cm, glabrous, covered with staminodes; upper portion cylindrical, ca 6 by 3 mm, composed of many staminate flowers; appendix narrowly lanceolate, up to 13 by 0.4 cm; scape 15–17 cm long, glabrous; spathe green 18–21 cm long; lower part, ovoid, 4 by 1.5–2 cm, glabrous; limb narrowly lanceolate, 14–17 by 1.3–1.5 cm, apex gradually narrowed to long acuminate apex, margin entire. **Flowers** unisexual, actinomorphic, sessile; perianth absent. **Staminate flowers** ca 1 mm in diam.; stamen 1; anther sessile, 4-celled up to 1 mm long, glabrous. **Pistillate flowers** 1 mm in diam.; ovary superior, ca 1 by 1 mm, glabrous, placentation marginal, 1-locular; stigma capitate, sessile, ca 0.25 mm in diam., glabrous. **Staminodes** dimorphic; upper ones narrowly deltoid, 2–3 by 1 mm; lower ones spatulate, 3–5 by 2 mm. **Fruit** a drupe, green, ellipsoid, ca 5 by 2–3 mm, glabrous. **Seed** not seen. **Plate 10.B.**

**Thailand.**— NORTH-EASTERN: Loei; PENNINSULAR: Trang.

**Distribution.**— India, Sri Lanka, Bangladesh, Bhutan, Indochina, Malesia and Northern Australia.

**Ecology.**— In seasonally flooded areas and old rice fielded. Flowering and fruiting from January to April.

**Vernacular.**— Ta phit kap yao (ตะพิดกาบขาว) (Loei).

**Specimen examined.**—*P. Pattarakulpisutti et al.* 204 (PSU).

### COMMELINACEAE

**79. *Commelina diffusa*** Burm.f., Fl. Ind. (N. L. Myanmar) 18, t. 7, f. 2. 1768; Backer & Bakh. f., Fl. Java (Spermatoph.) 3: 21. 1968; D. Hong & De Filippis in Fl. China 24: 18. 2000.

Annual to short-lived perennial herb, up to 60 cm high; stem quadrangular when young, glabrous. **Leaves** simple, alternate; sheath 1.5–2.5 cm long, covered with long hairs along margin; blade narrowly lanceolate to linear-lanceolate, 2.5–9 by 0.4–1.1 cm, chartaceous, glabrous, apex acute, margin entire. **Inflorescences** axillary, 2-scorpioided on each axil; flowers in lower branch caducous; peduncles of lower branch 0.8–1 cm long, hairy; peduncles of upper branch 1.5–1.8 cm long, hairy; bracts spathaceous, lanceolate-ovate, 1.7–2.7 by 0.9–1.8 cm, glabrous, apex acuminate, margin entire. **Flowers** zygomorphic, 1–1.5 cm in diam.; pedicels up to 6 mm long; bracteole not seen. **Calyx** pale purple, inner sepals connate at only at base, persistent, 5-lobed, glabrous; outer lobes deltoid, 3 by 1–2 mm, apex obtuse, margin entire; inner lobes elliptic-ovate, ca 4 by 3 mm, apex obtuse, margin entire. **Corolla** blue, free, petals 3, unequal; outer one reniform, ca 4 by 2 mm, glabrous, apex obtuse, margin entire, base truncate; inner ones ovate in outline, ca 6 by 2 mm, apex obtuse, margin entire, base claw. **Fertile stamens** 3, free; filaments 7–8 mm long, glabrous; anthers basifixed, 4-celled, 1–1.5 mm long, glabrous; staminodes 3, up ca 5 mm long, glabrous. **Ovary** superior, ca. 0.5 mm in diam., hairy, placentation axile, 3-loculed; style 1, ca 3 mm long, glabrous; stigma 1, capitate, ca 0.1 mm in diam., glabrous. **Fruit** a capsule loculicidal dehiscent, ellipsoid, ca 4 by 3 mm, trigonous, glabrous. **Seeds** not seen. **Plate 10.D.**

**Thailand.**— Throughout Thailand.

**Distribution.**— Tropics and subtropics.

**Ecology.**— Very common plants in wet and open places, roadsides and near rivers. Flowering and fruiting all year round.

**Vernacular.**— Phak plap (ผักปลาบ) (General).

**Specimens examined.**— *P. Pattarakulpisutti et al.* 232, 387 (PSU).

**80. *Cyanotis axillaris* (L.) D. Don ex Sweet, Hort. Brit.(Sweet) 430. 1826; Hook. f. in Fl. Brit. India (J. D. Hooker) 6: 388. 1892; Ridl., Fl. Malay. Penin. 4: 358. 1924; D. Hong & De Filippis in Fl. China 24: 18. 2000.**

Annual to short-lived perennial herb, up to 60 cm high; stem hairy. **Leaves** simple, alternate; sheath 5–7 mm long, hairy; blade linear, 3–9 by 0.4–0.7 cm, chartaceous, glabrous, apex acuminate, margin ciliolate. **Inflorescences** axillary, fasciculated, 3–6-flowered; peduncle absent. **Flowers** actinomorphic, 8–10 mm in diam., sessile; bracts papery, oblong, 2–3 by 1 mm, glabrous, apex acuminate, margin ciliolate. **Calyx** green, persistent, gamosepalous, 3-lobed, glabrous; tube ca 5 by 2 mm; lobes oblong, 4–5 by 2 mm, apex acuminate, margin entire. **Corolla** purple, gamopetalous, salverform, 3-lobed, glabrous; tube 6–7 by 0.5 mm; lobes broadly deltoid, ca 4 by 2.5 mm, glabrous, apex acute to obtuse, margin entire. **Stamens** 6, free, epipetalous; filaments 3–4 mm long, lanate; anthers basifixed, 2-celled, ca 1 mm long, glabrous. **Ovary** superior, ca 0.5 mm in diam., hairy, placentation axile, 3-loculed; style 1, ca 7 mm long, glabrous; stigma 1, clavate, ca 1 mm long, glabrous. **Fruit** a capsule, loculicidal dehiscent, ellipsoid, 4–5 by 2 mm, trigonous, glabrous. **Seeds** not seen. **Plate 10.E.**

**Thailand.**— Throughout Central and Peninsular of Thailand.

**Distribution.**— India, Sri Lanka, China, Indochina, Malesia and Australia.

**Ecology.**— Very common plants in wet and open places, roadsides and near river. Flowering and fruiting all year round.

**Vernacular.**— Kin kung luang (กินกึ่งหลวง) (Chiang Mai); Phak plap (ผักปลาบ) (Central); Phak plap na (ผักปลาบนา) (Bangkok); Ya pho phot lek (หญ้าพอดเล็ก) (Prachin Buri).

**Specimen examined.**— *P. Pattarakulpisutti et al.* 388 (PSU).

**81. *Murdannia nudiflora*** (L.) Brenan, Kew Bull. 189. 1952; D. Hong & De Filipps in Fl. China 30: 18. 2000.— *Commelina nudiflora* L., Sp. Pl. 1: 41. 1753; Hook. f. in Fl. Brit. India (J. D. Hooker) 6: 369. 1892; Ridl., Fl. Malay. Penin. 4: 352. 1924.

Annual herb up to 30 cm high; stem glabrous. **Leaves** simple, alternate; sheath 8–11 mm long, hairy; blade linear-lanceolate, 1.5–3.5 by 0.4–0.5 cm, chartaceous, glabrous, apex acuminate, margin scabrous. **Inflorescences** terminal, scorpioid, 3–6-flowered; peduncle 1–5 cm long, glabrous; proximal involucral bracts leaf-like, linear-lanceolate, ca 1.5 by 0.4 cm, glabrous, apex acuminate, margin scabrous; distal involucral bracts papery, lanceolate-oblong, 3–5 by 2 mm, glabrous, apex acuminate, margin entire. **Flowers** zygomorphic, 2.5–3 mm in diam.; pedicels up to 12 mm long, glabrous, bracteoles not seen. **Calyx** purplish-green, persistent, free, sepals 3, oblong to broadly oblong, 2 by 1–1.5 mm, glabrous, apex obtuse, margin entire. **Corolla** purple, free, petals 3, rhomboid to orbicular-rhomboid, ca 2 by 1.5 mm, glabrous, apex obtuse, margin entire. **Fertile stamens** 2, free; filaments 2.5–3 mm long, glabrous; anthers dorsifixed, 2-celled, ca 1 mm long, glabrous; staminodes 4, up to 1 mm long, glabrous. **Ovary** superior, ca 0.25 mm in diam., glabrous, placentation axile, 3-loculed; style 1, 1.5–2.5 mm long, glabrous; stigma 1, punctate. **Fruit** a capsule, loculicidal dehiscent, broadly ovoid, 3–4 by 2–3 mm, glabrous. **Seeds** not seen. *Plate 10.F.*

**Thailand.**— PENINSULAR: Surat Thani, Trang, Satun, Songkhla.

**Distribution.**— Bhutan, India, Sri Lanka, China, Japan, Indochina, Malesia, New Guinea and Pacific Islands.

**Ecology.**— Scattering on wet and open places, old rice fields. Flowering and fruiting from August to November.

**Vernacular.**— Kin kung noi (กินกุงน้อย) (Chiang Mai); Phak plap (ผักปลาบ) (General); Ya loen daeng (หญ้าเลนแดง) (Surat Thani).

**Specimen examined.**— *P. Pattarakulpisutti et al.* 452 (PSU).

## CYPERACEAE

**82. *Actinoscirpus grossus*** (L. f.) Goetgh. & D. A. Simpson, Kew Bull. 46(1): 171. 1991; D. A. Simpson & T. Koyama in Fl. Thailand. 6(4): 274, fig. 8a-f. 1998.— *Scirpus grossus* L. f. Suppl. Pl. 104. 1782; C. B. Clarke in Fl. Brit. India (J. D. Hooker) 6: 659. 1893; Ridl., Fl. Malay. Penin. 5: 142. 1925; Kern in Fl. Males., Ser. 1, Spermat. 7(3): 498, fig. 22. 1974.

Perennial herb; culm spongy, 140–150 by 0.5–1.5 cm, trigonous, glabrous. **Leaves** basal, few per culm; sheath open, up to 30 cm long, glabrous; ligule absent; blade linear, plicate, 30–107 by 1 cm, chartaceous, glabrous, apex gradually narrowed, margin serrulate. **Inflorescences** terminal, umbel-like, compound, branched; primary branches up to 5.5 cm long, scabrous; secondary branches up to 3 cm, scabrous; involucral bracts 3, leaf-like, linear, plicate, 6.5–60 by 0.3–0.7 cm, glabrous, apex gradually narrowed, margin serrulate. **Spikelets** solitary, sessile, ellipsoid, 2–3 by 2 mm. **Glumes** numerous per spikelet, spirally arranged, all fertile, brown, elliptic, ca 2 by 1.5 mm, membranous, scabrous, apex obtuse, margin ciliolate, keel green. **Flowers** bisexual. **Perianth segments** 6, filiform, ca 1 mm long, with bristles along margin. **Stamens** 3, free; filaments ca 0.25 mm long, glabrous; anthers basifixed, 2-celled, ca 1 mm long, glabrous. **Ovary** superior, ca 0.75 mm long, glabrous; style 1, continuous with ovary, ca 1 mm long, glabrous; stigma 3, filiform, ca 1.5 mm long, glabrous. **Fruit** a nutlet, brown, obovate, unequally trigonous, ca 1 by 0.5 mm, glabrous. **Plate 11.A.**

**Thailand.**— NORTHERN: Chiang Mai, Phayao, Nan, Sukothai, Phitsanulok; NORTH-EASTERN: Udon Thani, Kalasin, Maha Rarakham, Khon Kaen; SOUTH-WESTERN: Prachuap Kiri Khan; CENTRAL: Bangkok; SOUTH-



EASTERN: Chon Buri, Chanthaburi; PENINSULAR: Chumphon, Phangnga, Trang, Nakhon Si Thammarat, Phatthalung, Songkhla, Narathiwat.

**Distribution.**— India, Southern China, Taiwan, Malasia, Australia and Micronesia.

**Ecology.**— Emergent in shallow water, common in old rice fields, usually growing in large communities. Flowering and fruiting all year round.

**Vernacular.**— Maniu (มะนิ้ว), Ma nieo (มะเนี้ยว) (Northern); Haeo Kradaan (แห้วกระดาน), Haeo hin (แห้วหิน), Kok (กก), Kok prue (กกปรือ), Kok Saamlam (กกสามเหลี่ยม), Kok Takrap (กกตะกรับ), Kok taadaeng (กกตาแดง) (Central); Kok Khombaang (กกคมบาง) (Southwestern).

**Specimen examined.**— *P. Pattarakulpisutti et al.* 401 (PSU).

**83. *Cyperus babakan*** Steud., Syn. Pl. Glumac. 2(7): 6. 1854; Kern in Fl. Males., Ser. 1, Spermat. 7(3): 613. 1974; D. A. Simpson & T. Koyama in Fl. Thailand. 6(4): 363. 1998.— *C. babakensis* Steud. ex Miq., Fl. Ned. Ind. 3: 257. 1856; C. B. Clarke in Fl. Brit. India (J. D. Hooker) 6: 610. 1893; Ridl., Fl. Malay. Penin. 5: 144. 1925.

Perennial herb; culm 60–75 by 0.5–0.7 cm, trigonous, glabrous. **Leaves** basal, few per culm; sheath closed, 10–17 cm long, glabrous; ligule absent; blade linear, plicate, 9–60 by 0.5–0.8 cm, chartaceous, glabrous, apex gradually narrowed, margin entire. **Inflorescences** terminal, umbel-like, simple; primary branches 2–7 cm long, glabrous; involucre bracts 2–3, leaf-like, linear, plicate, 6–30 by 0.3–0.4 cm, glabrous, apex gradually narrowed, margin entire. **Spikes** elongated, ovoid to elliptic, 1–2 by 1.5 cm; axis scabrous. **Spikelets** narrowly oblong, 5–10 by 2–3 mm, glabrous. **Glumes** numerous per spikelet, 2-ranked, all fertile, brown, broadly elliptic, 2.5–3 by 2 mm, membranous, glabrous, apex acuminate, margin entire, keel green. **Flowers** bisexual. **Perianth segment** absent. **Stamens** 3, free; filaments short, glabrous; anthers dorsifixed, 2-celled, ca 0.75 mm long, glabrous. **Ovary** superior, ca 0.5 mm long, glabrous; style 1, continuous with ovary, ca 1 mm long, glabrous; stigma 3, filiform,

ca 1.5 mm long, glabrous. *Fruit* a nutlet, brown, broadly ellipsoid, unequally trigonous, ca 1 by 0.5 mm, glabrous. **Plate 11.B.**

**Thailand.**— SOUTH-EASTERN: Trat; PENINSULAR: Surat Thani, Nakhon Si Thammarat, Trang, Songkhla, Pattani, Narathiwat.

**Distribution.**— India, Indochina, Malesia and New Guinea.

**Ecology.**— Scattering in low abundance in rice fields and open marshy areas. Flowering and fruiting all year round.

**Vernacular.**— Kok liam (กกเหล็ย) (Narathiwat).

**Specimens examined.**— *P. Pattarakulpisutti et al.* 405, 427, 473 (PSU).

**84. *Cyperus compactus*** Retz., *Observ. Bot.*5: 10. 1789; Kern in Steenis, *Fl. Males.*, Ser. 1, *Spermat.* 7(3): 638. 1974; D. A. Simpson & T. Koyama in *Fl. Thailand.* 6(4): 379, fig. 27a-h, pl. XXVIII1-2. 1998.— *Mariscus microcephalus* J. Presl & C. Presl, *Reliq. Haenk.* 1(3): 182. 1828; C. B. Clarke in *Fl. Brit. India* (J. D. Hooker) 6: 624. 1893; Ridl., *Fl. Malay. Penin.* 5: 149. 1925.

Perennial herb; culm up to 100 by 1.5 cm, terete, glabrous. *Leaves* basal, few per culm; sheath closed, 21–27 cm long, glabrous; ligule absent; blade linear, 90–100 by 0.5–0.6 cm, chartaceous, glabrous, apex gradually narrowed, margin entire. *Inflorescences* terminal, umbel-like, compound; primary branches 2.5–11 cm long, glabrous; secondary branches 1.5–2.5 cm long, glabrous; involucre bracts 8, leaf-like, linear, 5–113 by 0.2–0.6 cm, glabrous, apex gradually narrowed, margin serrulate. *Spikes* elongated, globose, very dense, 1–1.5 cm in diam.; axis glabrous. *Spikelets* lanceolate to linear, 4–7 by 0.5 mm, glabrous. *Glumes* 5–7 per spikelet, 2-ranked, all fertile, linear-lanceolate to linear oblong, reddish brown, 2–4 by 1 mm, membranous, glabrous, apex obtuse, margin entire, keel green to pale brown. *Flowers* bisexual. *Perianth segment* absent. *Stamens* 3, free; filaments ca 0.5 mm long, glabrous; anthers basifixed, 2-celled, ca 0.5 mm long, glabrous. *Ovary* superior, ca 1.5 mm long, glabrous; style 1, continuous with ovary, ca 2mm long, glabrous;

stigma 3, filiform, ca 2 mm long, glabrous. **Fruit** a nutlet, pale brown, narrowly cylindrical, trigonous, 1.5–2 by 0.4–0.6 cm, glabrous. **Plate 11.C.**

**Thailand.**— Throughout Thailand.

**Distribution.**— Mascarenes, India, Sri Lanka, Indochina, Southern China, Taiwan and Malesia.

**Ecology.**— In rice fields and shallow water. Flowering and fruiting all year round.

**Vernacular.**— Ya bai khom (หญ้าไบกม) (Northern).

**Specimen examined.**— *P. Pattarakulpisutti et al.* 186 (PSU).

**85. *Cyperus digitatus*** Roxb., Fl. Ind., ed. Carey 1: 209. 1820; C. B. Clarke in Fl. Brit. India (J. D. Hooker) 6: 618. 1893; Kern in Fl. Males., Ser. 1, Spermat. 7(3): 601. 1974; D. A. Simpson & T. Koyama in Fl. Thailand. 6(4): 351.1998.

Perennial herb; culm 54–104 by 0.4–1.5 cm, trigonous, glabrous. **Leaves** basal, few per culm; sheath closed, 9–30 cm long, glabrous; ligule absent; blade linear, plicate, 15–40 by 0.2–1 cm, chartaceous, glabrous, apex gradually narrowed, margin entire. **Inflorescences** terminal, umbel-like, compound; primary branches 2–12.5 cm long, glabrous; secondary branches 3–5.5 cm long, glabrous; involucre bracts 3–8, leaf-like, linear, plicate, 5.5–55 by 0.4–1 cm, glabrous, apex gradually narrowed, margin serrulate. **Spikes** elongated, cylindrical, rather loose, 2–4 by 0.5–1.5 cm; axis glabrous. **Spikelets** linear, 4–10 by 1 mm, glabrous. **Glumes** 9–16 per spikelet, 2-ranked, all fertile, pale brown, oblanceolate-elliptic, ca 2 by 1 mm, membranous, glabrous, apex apiculate, margin entire, keel green to pale brown. **Flowers** bisexual. **Perianth segment** absent. **Stamens** 3, free; filaments ca 0.5 mm long, glabrous; anthers basifixed, 2-celled, ca 0.25 mm long, glabrous. **Ovary** superior, ca 1 mm long, glabrous; style 1, continuous with ovary, ca 1 mm long, glabrous; stigma 3, filiform, ca 0.75 mm long, glabrous. **Fruit** a nutlet, brown, narrowly-ellipsoid, trigonous, ca 1 by 0.25 mm, glabrous. **Plate 11.D.**

**Thailand.**— Throughout Thailand.

**Distribution.**— Pantropics, Southern China and Taiwan.

**Ecology.**— Usually emergent on shallow water, river banks and rice fields. Flowering and fruiting all year round.

**Vernacular.**— Kok dok daeng (กกดอกแดง), Kok rang kaa (กกร้างกา), Yaa rangkaa (หญ้าร้างกา) (Central).

**Specimens examined.**— *P. Pattarakulpisutti et al.* 403, 448 (PSU).

**86. *Cyperus elatus*** L. Cent. Pl. 2. 301. 1756; C. B. Clarke in Fl. Brit. India (J. D. Hooker) 6: 618. 1893; Ridl., Fl. Malay. Penin. 5: 148. 1925; Kern in Fl. Males., Ser. 1, Spermat. 7(3): 601. 1974; D. A. Simpson & T. Koyama in Fl. Thailand. 6(4): 349. 1998.

Perennial herb; culm 107–136 by 1 cm, trigonous, glabrous. **Leaves** basal, few per culm; sheath closed, 30–45 cm long, glabrous; ligule absent; blade linear, plicate, up to 100 by 0.5–0.7 cm, chartaceous, glabrous, apex gradually narrowed, margin serrulate. **Inflorescences** terminal, umbel-like, compound; primary branches 10–20 cm long, glabrous; secondary branches 3–5 cm long, glabrous; involucre bracts 5–7, leaf-like, linear, plicate, 24–65 by 0.5–1.5 cm, glabrous, apex gradually narrowed, margin serrulate. **Spikes** elongated, narrowly cylindrical, dense, 2.5–5 by 0.3–0.5 mm; axis glabrous. **Spikelets** linear, 4–5 by 1 mm, glabrous. **Glumes** 9–15 per spikelet, 2-ranked, all fertile, pale brown, ovate, ca 2 by 1 mm, membranous, glabrous, apex apiculate, margin entire, keel green to pale brown. **Flowers** bisexual. **Perianth segment** absent. **Stamens** 3, free; filaments ca 0.5 mm long, glabrous; anthers basifixed, 2-celled, ca 0.5 mm long, glabrous. **Ovary** superior, ca 0.75 mm long, glabrous; style 1, continuous with ovary, ca 1 mm long, glabrous; stigma 3, filiform, ca 0.75 mm long, glabrous. **Fruit** a nutlet, pale brown, narrowly-ellipsoid, trigonous, ca 1 by 0.25 mm, glabrous. **Plate 11.E.**

**Thailand.**— CENTRAL: Bangkok; PENINSULAR: Chumphon, Trang, Narathiwat.

**Distribution.**— India and Malesia.

**Ecology.**— Usually emergent in shallow water, rice fields and river banks. Flowering and fruiting all year round.

**Vernacular.**— Kok krachai (กกกระชาย) (Central).

**Specimens examined.**— *P. Pattarakulpisutti et al.* 449–1, 459 (PSU).

**87. *Cyperus haspan*** L., Sp. Pl. 1: 45. 1753; C. B. Clarke in Fl. Brit. India (J. D. Hooker) 6: 600. 1893; Ridl., Fl. Malay. Penin. 5: 142. 1925; Kern in Fl. Males., Ser. 1, Spermat. 7(3): 624, fig. 56-57. 1974; D. A. Simpson & T. Koyama in Fl. Thailand. 6(4): 371. 1998.

Annual or perennial herb; culm 30–77 by 0.2–0.4 cm, trigonous, glabrous. **Leaves** basal, few per culm; sheath closed, 2–21 cm long, glabrous; ligule absent; blade linear, plicate, 3–23 by 0.3–0.5 cm, chartaceous, glabrous, apex gradually narrowed, margin serrulate. **Inflorescences** terminal, umbel-like, simple to compound; primary branches 2–8 cm long, glabrous; secondary branches 1–2 cm long, glabrous; involucre bracts 2–3, leaf-like, linear, plicate, 2–13 by 0.1–0.5 cm, glabrous, apex gradually narrowed, margin entire. **Spikelets** in digitately arranged, lanceolate to linear, 5–7 by 1–2 mm, glabrous. **Glumes** 9–14 per spikelet, 2-ranked, all fertile, pale brown to reddish brown, oblong, 1.2–1.5 by 1 mm, membranous, glabrous, apex obtuse, margin entire, keel green to pale brown. **Flowers** bisexual. **Perianth segment** absent. **Stamens** 1–3, free; filaments ca 0.75 mm long, glabrous; anthers basifixed, 2-celled, ca 0.5 mm long, glabrous; connective with bristle at apex. **Ovary** superior, 0.25–0.75 mm long, glabrous; style 1, continuous with ovary, ca 0.5 mm long, glabrous; stigma 3, filiform, 0.5–1 mm long, glabrous. **Fruit** a nutlet, pale brown, broadly obovoid, trigonous, ca 0.5 by 0.4 mm, glabrous.

**Thailand.**— Throughout Thailand.

**Distribution.**— The Tropics and subtropics.

**Ecology.**— Very common in rice fields and open-swamp areas, more abundant in flood season, disappear in dry season.

**Vernacular.**— Kok naa (กกนา) (Trang); Yaa kok chaai (Prachin Buri).

**Specimen examined.**— *P. Pattarakulpisutti et al.* 207 (PSU).

**88. *Cyperus imbricatus*** Retz., *Observ. Bot.* 5: 12. 1788; Kern in *Fl. Males.*, Ser. 1, *Spermat.* 7(3): 603. 1974; D. A. Simpson & T. Koyama in *Fl. Thailand.* 6(4): 350. 1998.— *C. radiatus* Vahl, *Enum. Pl. (Vahl)* 2. 369. 1805; C. B. Clarke in *Fl. Brit. India (J. D. Hooker)* 6: 617. 1893; Ridl., *Fl. Malay. Penin.* 5: 147. 1925.

Perennial herb; culm ca 80 by 0.3 cm, trigonous, glabrous. **Leaves** basal, few per culm; sheath closed, ca 23 cm long, glabrous; ligule absent; blade linear, ca 60 by 0.5 cm, chartaceous, glabrous, apex gradually narrowed, margin entire. **Inflorescences** terminal, umbel-like, simple; primary branches 2–4.5 cm long, glabrous; involucre bracts ca 5, leaf-like, linear, 9–60 by 0.4–0.5 cm, glabrous, apex gradually narrowed, margin entire. **Spikes** elongated, narrowly cylindrical, dense, 15–30 by 1–2 mm; axis winged. **Spikelets** ovate, 2–4 by 1 mm, glabrous. **Glumes** 5–9 per spikelet, 2-ranked, all fertile, pale brown, ovate, 1–1.5 by 1 mm, membranous, glabrous, apex mucronate, margin entire, keel green. **Flowers** bisexual. **Perianth segment** absent. **Stamens** 3, free; filaments ca 0.3 mm long, glabrous; anthers basifixed, 2-celled, ca 0.3 mm long, glabrous. **Ovary** superior, ca 0.5 mm long, glabrous; style 1, continuous with ovary, ca 0.75 mm long, glabrous; stigma 3, filiform, ca 0.5 mm long, glabrous. **Fruit** a nutlet, pale brown, narrowly ellipsoid, unequally trigonous, ca 0.75 by 0.25 cm, glabrous. **Plate 11.F.**

**Thailand** — NORTHERN: Mae Hong Son, Chaing Mai, Tak, Nakhon Sawan; NORTH-EASTERN: Nakhon Phanom, Khon Kaen; EASTERN: Buri Ram; CENTRAL: Bangkok, Chai nat, Ang thong; SOUTH-WESTERN: Kanchanaburi; PENINSULAR: Trang.

**Distribution.**— Pantropics.

**Ecology.**— Very common in rice fields and open swamp areas, more abundant in flood season, sometime disappear in dry season.

**Vernacular.**— Kok (กอก) (Central).

**Specimen examined.**— *P. Pattarakulpisutti et al.* 449–2 (PSU).

**89. *Cyperus iria*** L., Sp. pl. 1: 45. 1753; C. B. Clarke in Fl. Brit. India (J. D. Hooker) 6: 606. 1893; Ridl., Fl. Malay. Penin. 5: 143. 1925; Kern in Fl. Males., Ser. 1, Spermat. 7(3): 616. 1974; D. A. Simpson & T. Koyama in Fl. Thailand. 6(4): 364.1998.

Annual herb; culm few, 25–39 cm by 0.5–1 mm, sharply trigonous, glabrous. **Leaves** basal, several per culm; sheath closed, 1.5–10 cm long, glabrous; ligule absent; blade linear, plicate, 1.5–16 cm by 1.5–3 mm, chartaceous, glabrous, apex gradually narrowed, margin entire. **Inflorescences** terminal, umbel-like, simple to compound; primary branches 0.2–4.5 cm long, glabrous to scabrous; secondary branches up to 3 mm long, glabrous; involucral bracts 5–7, leaf-like, linear, plicate, 3–7 by 1.5–3.5 cm, glabrous, apex gradually narrowed, margin entire to serrulate. **Spikes** elongated, narrowly cylindrical, loose, 7–25 by 1–2 mm; axis glabrous. **Spikelets** oblong-elliptic, 2–3 by 1 mm, glabrous. **Glumes** 4–7 per spikelet, 2-ranked, all fertile, brownish yellow, broadly obovate, 1.25–1.5 by 0.75–1 mm, membranous, glabrous, apex obtuse, margin entire, keel green. **Flowers** bisexual. **Perianth segment** absent. **Stamens** 2, free; filaments ca 0.25 mm long, glabrous; anthers basifixed, 2-celled, ca 0.25 mm long, glabrous. **Ovary** superior, ca 0.5 mm long, glabrous; style 1, continuous with ovary, ca 0.5 mm long, glabrous; stigma 3, filiform, ca 0.25 mm long, glabrous. **Fruit** a nutlet, yellowish brown, ellipsoid, sharply trigonous, 1.25–1.5 by 0.75–1 mm, punctate.

**Thailand.**— Throughout Thailand.

**Distribution.**— Tropical Asia, China, Japan, Australia and Eastern Africa.

**Ecology.**— Scattering in low abundance on open and dry places, more abundant in flood season, disappear in dry season.

**Vernacular.**— Yaa kok saai (หญ้ากกทราย) (Northern); Yaa rangkaa (หญ้าร้างกา), Hangkaa khaao (หางกาขาว) (Northeastern); Kok hua daeng (กกหัวแดง), yaa hua daeng (หญ้าหัวแดง), Yaa kok lek (หญ้ากกเล็ก) (Central)

**Specimen examined.**— *P. Pattarakulpisutti et al.* 517 (PSU).

**90. *Cyperus pilosus*** Vahl, Enum. Pl. (Vahl) 2. 354. 1805; C. B. Clarke in Fl. Brit. India (J. D. Hooker) 6: 609. 1893; Ridl., Fl. Malay. Penin. 5: 144. 1925; Kern in Fl. Males., Ser. 1, Spermat. 7(3): 611. 1974; D. A. Simpson & T. Koyama in Fl. Thailand. 6(4): 362. 1998.

Annual on some special condition or perennial herb; culm few, 26–90 by 0.2–0.4 cm, sharply trigonous, glabrous. **Leaves** basal, few per culm; sheath closed, 2–14 cm long, glabrous; ligule absent; blade linear, plicate, 33–40 by 0.7–1 cm, chartaceous, glabrous, apex gradually narrowed, margin entire. **Inflorescences** terminal, umbel-like, compound; primary branches 1.5–11 cm long, glabrous; secondary branches up to 4 mm long, glabrous; involucre bracts 4–5, leaf-like, linear, plicate, 5–23 by 0.2–0.8 cm, glabrous, apex gradually narrowed, margin serrulate. **Spikes** elongated, oblong, loose, 10–25 by 8–20 mm; axis covered with bristles. **Spikelets** narrowly lanceolate to linear-oblong, 4–10 by 1–2 mm, glabrous. **Glumes** 9–13 per spikelet, 2-ranked, all fertile, reddish brown, ovate, up to 2 by 2 mm, membranous, glabrous, apex obtuse, margin entire, keel green. **Flowers** bisexual. **Perianth segment** absent. **Stamens** 3, free; filaments ca 0.25 mm long, glabrous; anthers basifixed, 2-celled, ca 0.5 mm long, glabrous. **Ovary** superior, ca 0.75 mm long, glabrous; style 1, continuous with ovary, ca 0.5 mm long, glabrous; stigma 3, filiform, ca 1 mm long, glabrous. **Fruit** a nutlet, pale brown, ellipsoid, sharply trigonous, ca 1.25 by 0.5 mm, glabrous. **Plate 11.G.**

**Thailand.**— NORTHERN: Mae Hong Son, Chiang Mai, Chiang Rai, Nan, Phisanulok; NORTH-EASTERN: Khon kaen; EASTERN: Chaiyaphum;



SOUTH-WESTERN: Kanchanaburi; SOUTH-EASTERN: Chon Buri, Chanthaburi, PENINSULAR: Surat Thani, Phangnga, Trang, Songkhla, Yala.

**Distribution.**— Old world tropics and subtropics.

**Ecology.**— Very common in rice fields and open-swamp areas, more abundant during flood season, disappear during dry season.

**Vernacular.**— Kok cho dok khon (หญ้าหางกา) (General).

**Specimens examined.**— *P. Pattarakulpisutti et al.* 424, 429, 453, 459 (PSU).

**91. *Cyperus pulcherrimus*** Willd. ex Kunth, Enum. Pl. (Kunth) 2. 35. 1837; C. B. Clarke in Fl. Brit. India (J. D. Hooker) 6: 600. 1893; Ridl., Fl. Malay. Penin. 5: 142. 1925; Kern in Fl. Males., Ser. 1, Spermat. 7(3): 624. 1974; D. A. Simpson & T. Koyama in Fl. Thailand. 6(4): 371. 1998.

Annual or perennial herb; culm 36–55 by 0.1–0.3 cm, trigonous, glabrous. **Leaves** basal, few per culm; sheath closed, 3–11 cm long, glabrous; ligule absent; blade linear, plicate, 6–50 by 0.3–0.4 cm, chartaceous, glabrous, apex gradually narrowed, margin entire. **Inflorescences** terminal, umbel-like, compound to decompose; primary branches 1.5–4 cm long, glabrous; secondary branches 1–1.5 cm long, glabrous; tertiary branches up to 7 mm; involucre bracts 3–6, leaf-like, linear, plicate, 8–26 by 0.2–0.4 cm, glabrous, apex gradually narrowed, margin serrulate. **Spikelets** in digitately arranged, linear-oblong, 3–6 by 1.5 mm, glabrous. **Glumes** numerous per spikelet, 2-ranked, all fertile, brown, ovate, 0.75–1 by 0.8 mm, incurved membranous, glabrous, apex obtuse, margin entire, keel green to pale red. **Flowers** bisexual. **Perianth segment** absent. **Stamen** 1, free; filament ca 0.3 mm long, glabrous; anther basifixed, 2-celled, ca 0.3 mm long, glabrous. **Ovary** superior, ca 0.25 mm long, glabrous; style 1, continuous with ovary, ca 0.5 mm long, glabrous; stigma 3, filiform, ca 0.25 mm long, glabrous. **Fruit** a nutlet, pale brown, broadly ellipsoid, trigonous, ca 0.4 by 0.3 mm, glabrous. **Plate 11.H.**

**Thailand.**— Throughout Thailand.

**Distribution.**— India, Sri Lanka, Indochina, Malesia.

**Ecology.**— Very common in rice fields and open-swamp areas, more abundant during flood season, disappear during dry season.

**Vernacular.**— Ya hand ka (หญ้าหางกา) (Northeastern).

**Specimens examined.**— *P. Pattarakulpisutti et al.* 222, 274, 419 (PSU).

**92. *Eleocharis acutangula*** (Roxb.) Schult., Mant. 2 (Schultes): 91. 1824.; Kern in Fl. Males., Ser. 1, Spermat. 7(3): 325. 1974; D. A. Simpson & T. Koyama in Fl. Thailand. 6(4): 285, fig. 12a-g. 1998.— *E. fistulosa* Schult., Mant. 2 (Schultes) 89. 1824; C. B. Clarke in Fl. Brit. India (J. D. Hooker) 6: 626. 1893; Ridl., Fl. Malay. Penin. 5: 151. 1925

Perennial herb; culm tufted, spongy, 18–46 by 0.2–0.4 cm, sharply trigonous, glabrous. **Leaves** basal, reduced to bladeless sheath, several per culm; sheath closed, 5–13 cm long, glabrous, apex acute; ligule absent. **Inflorescences** terminal, 1-spikeleted, glabrous; involucre bract 1, glume-like, ovate, 3–4 by 3 mm, glabrous, apex acute, margin entire. **Spikelets** solitary, cylindrical, 1.5–3 by 0.3–0.4 cm. **Glumes** numerous per spikelet, spirally arranged, all fertile, green, ovate, 4–5 by 2.5–2 mm, membranous, glabrous, apex subacute, margin entire. **Flowers** bisexual. **Perianth segments** 6, persistent, filiform, ca 1 mm long, with bristles along margin. **Stamen** not seen. **Ovary** superior, 0.5–1 mm long, glabrous; style 1, jointed with ovary, up to 3 mm long, glabrous, style-base deltoid, persistent; stigma 2, filiform, ca 0.5 mm long, glabrous. **Fruit** a nutlet, yellowish brown, obovate, biconvex, ca 1.75–2 by 1.25 mm, surface reticulated, apex constricted. **Plate 12.C.**

**Thailand.**— NORTHERN: Chiang Mai; SOUTH-EASTERN: Trat; PENINSULAR: Phuket, Trang, Pattani, Songkhla.

**Distribution.**— Pantropics.

**Ecology.**— Very common in rice fields, open-swamp areas and shallow water. Flowering and fruiting all year round.

**Vernacular.**— Prong liam (โพรงเหลี่ยม) (Trant).

**Specimens examined.**— *P. Pattarakulpisutti et al.* 423, 428 (PSU).

**93. *Fimbristylis acuminata*** Vahl, Enum. Pl. (Vahl) 2. 285. 1805; C. B. Clarke in Fl. Brit. India (J. D. Hooker) 6: 631. 1893; Ridl., Fl. Malay. Penin. 5: 123. 1925; Kern in Fl. Males., Ser. 1, Spermat. 7(3): 588. 1974; D. A. Simpson & T. Koyama in Fl. Thailand. 6(4): 339. 1998.— *F. setacea* Benth., London J. Bot. 2: 239. 1843; C. B. Clarke in Fl. Brit. India (J. D. Hooker) 6: 632. 1893; Ridl., Fl. Malay. Penin. 5: 153. 1925.

Annual or short-lived perennial herb; culm densely tufted, 8.5–20 cm by 0.5 mm, trigonous, glabrous. **Leaves** reduced to basal sheath, few per culm; sheath closed, 5–25 mm long, glabrous; ligule absent. **Inflorescences** terminal, single spikelet; involucre bract 1, glume-like, narrowly deltoid, 2–3 by 1 mm, glabrous, apex mucronate, margin entire. **Spikelets** solitary, sessile, lanceolate to narrowly lanceolate, 4–7 by 1–2 mm. **Glumes** 5–15 per spikelet, spirally arranged, all fertile, pale brown, broadly elliptic to ovate-elliptic, 3–4 by 1.5–2 mm, chartaceous, glabrous, apex mucronate, margin entire, keel pale brown. **Flowers** bisexual. **Perianth segment** absent. **Stamens** 2, free; filaments ca 0.5 mm, glabrous; anthers basifixed, 2-celled, ca 1.5 mm long, glabrous. **Ovary** superior, ca 1 mm long, glabrous; style 1, jointed with ovary, ca 2.5 mm long, glabrous; stigma 2, filiform, ca 0.5 mm long, ciliolate. **Fruit** a nutlet, creamy white, obovate to orbicular, biconvex, 1.5–2 by 1.5–2, wrinkled, glabrous.

**Thailand.**— NORTH-EASTERN: Sakon Nakhon, Kalasin, Kon Kaen; SOUTH-EASTERN: Chon Buri, Chanthaburi, Trat; PENINSULAR: Chumphon, Ranong, Surat Thani, Phangnga, Phuket, Nakhon Si Thammarat, Trang, Narathiwat.

**Distribution.**— India, Sri Lanka, Southern China, Ryukyu Islands, Malesia and Northern Australia.

**Ecology.**— In rather dry and open areas, old rice fields, more abundant during dry season, disappear during flood season.

**Vernacular.**— Yaa nuat plaa duk (หมวดปลาตุก) (Southwestern); phroung klom noi (โพรงกลน้อย), Yaa plueak krathiam saai (หญ้าเปลือกกระเทียมทราย) (Peninsular).

**Specimen examined.**— *P. Pattarakulpisutti et al.* 485 (PSU).

**94. *Fimbristylis miliacea* (L.) Vahl, Enum. Pl. (Vahl) 2: 287. 1805; C. B. Clarke in Fl. Brit. India (J. D. Hooker) 6: 644. 1893; Ridl., Fl. Malay. Penin. 5: 158. 1925; D. A. Simpson & T. Koyama in Fl. Thailand. 6(4): 371.1998.— *F. littoralis* Gaudich., Voy. Uranie, Bot. 413. 1829; Kern in Fl. Males., Ser. 1, Spermat. 7(3): 325. 1974.**

Annual or perennial herb; culm tufted, 34–37 by 0.1 cm, quadrangular, glabrous. **Leaves** basal or cualine, reduced to bladeless sheath, few per culm; basal sheath closed, 3–10 cm long, glabrous; ligule absent; cualine sheath tubular, 2–9 cm long, glabrous; blade linear, 1.5–16 by 0.1–0.4 cm, chartaceous, glabrous, apex gradually narrowed, margin entire. **Inflorescences** terminal, umbel-like, compound to decompose; primary branches 2–3.5 cm long, scabrous; secondary branches up to 1.5 cm, scabrous; tertiary branches up to 0.5 cm, scabrous; involucral bracts 2–4, leaf-like, filiform, 5–20 by 0.1 mm, glabrous, apex acute, margin serrulate. **Spikelets** solitary, sessile, ovoid, 2–3 by 2 mm. **Glumes** numerous per spikelet, spirally arranged, all fertile, reddish brown, broadly ovate, ca 1 by 0.5 mm, membranous, glabrous, apex obtuse, margin entire, keel pale yellow. **Flowers** bisexual. **Perianth segment** absent. **Stamens** 1–2, free; filaments ca 0.25 mm, glabrous; anthers basifixed, 2-celled, ca 0.5 mm long, glabrous. **Ovary** superior, ca 0.5 mm long, glabrous; style 1, jointed with ovary, ca 0.5 mm long, glabrous; stigma 3, filiform, ca 0.5 mm long, glabrous. **Fruit** a nutlet, yellowish-brown, obovoid, trigonous, ca 0.5 by 0.25 mm, cancellate.

**Thailand.**— Throughout Thailand.

**Distribution.**— Tropics and subtropics.

**Ecology.**— Very common in rice fields and open-swamp areas, more abundant during flood season, disappear during dry season.

**Vernacular.**— Yaa rat khiat (หญ้าไร่ดเคียด) (Northern); Nuat plaa duk (หนวดปลาตุก) (Peninsular).

**Specimens examined.**— *P. Pattarakulpisutti et al.* 406, 491–2 (PSU).

**95. *Fimbristylis schoenoides*** (Retz.) Vahl, Enum. Pl. (Vahl) 2. 286. 1805; C.B. Clarke in Fl. Brit. India (J. D. Hooker) 6: 634. 1893; Ridl., Fl. Malay. Penin. 5: 154. 1925; Kern in Fl. Males., Ser. 1, Spermat. 7(3): 573. 1974; D. A. Simpson & T. Koyama in Fl. Thailand. 6(4): 320.1998.

Annual or perennial herb; culm tufted, 7–20 by 0.1 cm, quadrangular, glabrous. **Leaves** basal, few per culm; sheath closed, 1.5–4.8 cm long, glabrous; ligule a fringe of dense short hairs; blade narrowly linear, 0.8–7.8 by 0.1 cm, chartaceous, glabrous, apex gradually narrowed, margin serrulate. **Inflorescences** terminal, single spikelet to simple umbel-like; primary branches up to 1.5 cm long, glabrous; involucre bracts 1–2, glume-like rarely leaf-like, glume-like ones ovate to lanceolate, 1.5–2 by 1–1.5 mm, glabrous, apex acuminate to aristate, margin entire, leaf-like ones filiform, ca 10 by 2 mm, glabrous, apex acute, margin entire. **Spikelets** solitary, sessile, ellipsoid, 3–15 by 2–5 mm. **Glumes** numerous per spikelet, spirally arranged, all fertile, pale brown, ovate-orbicular, 2.5–3 by 2–3 mm, chartaceous, glabrous, apex mucronate, margin entire, keel green. **Flowers** bisexual. **Perianth segment** absent. **Stamens** 2, free; filaments ca 0.25 mm, glabrous; anthers basifixed, 2-celled, ca 0.75 mm long, glabrous. **Ovary** superior, ca 1 mm long, glabrous; style 1, jointed with ovary, 2–2.5 mm long, upper half ciliolate; stigma 2, filiform, up to 2 mm long, glabrous. **Fruit** a nutlet, whitish-yellow, obovate-orbicular, biconvex, ca 1 by 0.1 mm, glabrous.

**Thailand.**— NORTHEN: Mae Hong Son, Chiang Mai; NORTH-EASTERN: Maha Sarakham, Khon Kaen; SOUTH-WESTERN: Prachuap Khiri Khan; SOUTH-EASTERN: Chanthaburi, Trat; PENINSULAR: Surat Thani, Phangnga, Krabi, Trang, Songkhla.

**Distribution.**— India, South-eastern China and Taiwan, Malesia and Northern Australia.

**Ecology.**— Very common in rice fields and open-swamp areas, more abundant during flood season, sometime disappear during dry season.

**Vernacular.**— Yaa hang nuu (หญ้าทางหนู) (Peninsular).

**Specimens examined.**— *P. Pattarakulpisutti et al.* 436–2, 455–1, 482, 484 (PSU).

**96. *Fimbristylis tetragona*** R. Br., Prodr. Fl. Nov. Holland. 226. 1810; C. B. Clarke in Fl. Brit. India (J. D. Hooker) 6: 631. 1893; Ridl., Fl. Malay. Penin. 5: 153. 1925; Kern in Fl. Males., Ser. 1, Spermat. 7(3): 590. 1974; D. A. Simpson & T. Koyama in Fl. Thailand. 6(4): 340, fig. 22a-e. 1998.

Perennial herb; culm tufted, 16.5–53 by 0.1 cm, quadrangular, glabrous. **Leaves** basal, reduced to bladeless sheath, few per culm; sheath closed, 3–4.5 cm long, glabrous, apex acute; ligule absent. **Inflorescences** terminal, single spikelet; involucral bracts 1–2, glume-like, oblong-elliptic, 2.5–4 by 1.5–2 mm, glabrous, apex obtuse, margin entire. **Spikelets** solitary, sessile, broadly ellipsoid, 5–10 by 4–6 mm. **Glumes** numerous per spikelet, spirally arranged, all fertile, pale brown, oblong-elliptic, 3–4 by 2 mm, chartaceous, glabrous, apex obtuse, margin entire, keel pale brown. **Flowers** bisexual. **Perianth segment** absent. **Stamen** 1, free; filament ca 1 mm long, glabrous; anther basifixed, 2-celled, up to 2 mm long, glabrous. **Ovary** superior, ca 2 mm long, glabrous; style 1, jointed with ovary, up to 2 mm long, ciliolate; stigma 2–3, filiform, up to 1 mm long, glabrous. **Fruit** a nutlet, whitish-yellow, linear-oblong, biconvex, ca 2 by 0.5 mm, cancellate. **Plate 12.A.**

**Thailand.**— NORTHERN: Chiang Mai; EASTERN: Surin; PENINSULAR: Trang, Satun.

**Distribution.**— India, Southern China and Taiwan, Malesia and Northern Australia.

**Ecology.**— Scattered in rice fields. Flowering and fruiting all year round.

**Vernacular.**— Kok kan dok (กกก้านดอก) (General).

**Specimen examined.**— *P. Pattarakulpisutti et al.* 457.

**97. *Fimbristylis umbellaris*** (Lam.) Vahl, Enum. Pl. 2: 296. 1806; D. A. Simpson & T. Koyama in Fl. Thailand. 6(4): 310. 1998.— *F. globulosa* (Retz.) Kunth, Enum. Pl. (Kunth) 2: 231. 1837; C. B. Clarke in Fl. Brit. India (J. D. Hooker) 6: 644. 1893; Ridl., Fl. Malay. Penin. 5: 158. 1925; Kern in Fl. Males., Ser. 1, Spermat. 7(3): 551. 1974.

Annual or perennial herb; culm tufted, 10–60 by 0.1–0.3 cm, quadrangular, glabrous. **Leaves** basal or culine, reduced to bladeless sheaths, few per culm; sheaths closed, 2–20 cm long, glabrous; ligule absent, apex acute. **Inflorescences** terminal, umbel-like simple to compound; primary branches 1–3 cm long, glabrous; secondary branches up to 1.3 cm, glabrous; involucre bracts 2–3, glume-like, narrowly deltoid, 3–5 by 1 mm, glabrous, apex acute, margin entire. **Spikelets** solitary, sessile, ovoid to ellipsoid, 2–7 by 2–3 mm. **Glumes** numerous per spikelet, spirally arranged, all fertile, reddish brown, ovate-elliptic to ovate, ca 2 by 1.5 mm, membranous, glabrous, apex obtuse, margin entire, keel green. **Flowers** bisexual. **Perianth segment** absent. **Stamens** 3, free; anthers sessile, basifixed, 2-celled, ca 1 mm long, glabrous. **Ovary** superior, ca 0.25 mm long, glabrous; style 1, jointed with ovary, ca 1.25 mm long, glabrous; stigma 3, filiform, up to 1.5 mm long, ciliolate. **Fruit** a nutlet, pale yellow, obovate, biconvex, ca 1 by 0.75 mm, cancellate, sparsely verruculose.

**Thailand.**— Throughout Thailand.

**Distribution.**— India, Indochina, Southern China, Ryukyu Islands, Malesia, Micronesia and Polynesia.

**Ecology.**— Very common in rice fields and open-swamp areas. Flowering and fruiting all year round.

**Vernacular.**— Phrong klom noi (พรงกลมน้อย) (Peninsular).

**Specimens examined.**— *P. Pattarakulpisutti et al.* 422, 454, 461, 466, 468, 467, 476, 491, 502, 642 (PSU).

**98. *Kyllinga brevifolia*** Rottb., Descr. Icon. Rar. Pl. 13, t. 4, fig. 3. 1773; C. B. Clarke in Fl. Brit. India (J. D. Hooker) 6: 588. 1893; Ridl., Fl. Malay. Penin. 5: 138. 1925; D. A. Simpson & T. Koyama in Fl. Thailand. 6(4): 399, pl. XXIX1-2. 1998.— *Cyperus brevifolius* (Rottb.) Hassk., Cat. Hort. Bot. Bogor. (Hasskarl) 24. 1844; Kern in Fl. Males., Ser. 1, Spermat. 7(3): 656. 1974.

Perennial herb; culm 26–48 by 0.1 cm, sub-terete, glabrous. **Leaves** distichous, few per culm; sheath closed, 2–15 cm long, glabrous; ligule absent; blade linear, plicate, 1–14 by 0.2–0.3 cm, chartaceous, glabrous, apex gradually narrowed, margin entire. **Inflorescences** terminal, head-like, 1–2-spiked; involucre bracts 3–4, leaf-like, linear, plicate, 0.5–13 by 0.1–0.3 cm, glabrous, apex acuminate, margin serrulate. **Spikes** ovoid to globose, 3–8 by 3–6 mm; axis glabrous. **Spikelets** sessile, lanceolate to ovate-lanceolate, 2–2.5 by 1–1.5 mm. **Glumes** 4 per spikelet, 2-ranked, 1–2 flowered, light green to pale brown; the first elliptic-lanceolate, 2–2.5 by 1 mm, membranous, glabrous, apex acuminate, margin entire, keel green, scabrous; the second ovate, ca 2 by 1.8 mm, membranous, glabrous, apex acuminate, margin entire, keel green, scabrous; the third and the fourth boat-shaped, ca 0.75 by 0.5 mm, membranous, glabrous, apex mucronulate, margin entire, keel membranous. **Flowers** bisexual. **Perianth segment** absent. **Stamens** 1–2, free; filaments 0.25–0.5 mm long, glabrous; anthers basifixed, 2-celled, 0.5–0.75 mm long, glabrous. **Ovary** superior, ca 1 mm long, glabrous; style 1, continuous with ovary, ca 1 mm long, glabrous; stigma 2, filiform, ca 0.75 mm long, glabrous. **Fruit** a nutlet, yellowish brown, oblong to elliptic, biconvex, ca 1.5 by 0.8 mm, glabrous. **Plate 12.B.**

**Thailand.**— Throughout Thailand.

**Distribution.**— Tropics, subtropics and warm temperate region.



**Ecology.**— In rather dry and open areas, roadsides, seasonally flooded areas and margin of rice fields. More abundant during dry season, disappear during flood season.

**Vernacular.**— Yaa ka dok khaao (หญ้าคาดอกขาว) (Central); Yaa hua mong (หญ้าหัวโหมง) (Peninsular).

**Specimens examined.**— *P. Pattarakulpisutti et al.* 457–2, 446 (PSU).

**99. *Lipocarpa microcephala*** (R. Br.) Kunth, Enum. Pl. (Kunth) 2: 268. 1837; C .B. Clarke in Fl. Brit. India (J. D. Hooker) 6: 668. 1893; Ridl., Fl. Malay. Penin. 5: 163. 1925; Kern in Fl. Males., Ser. 1, Spermat. 7(3): 552. 1974; D. A. Simpson & T. Koyama in Fl. Thailand. 6(4): 379, fig. 34a-h. 1998.

Annual herb; culm tufted, 10–18 by 0.5–1 cm, terete, glabrous. **Leaves** distichous, few per culm; sheath closed, 2–4 cm long, glabrous; ligule absent; blade linear, plicate, 5–30 by 2–3 mm, chartaceous, glabrous, apex acute, margin entire. **Inflorescences** terminal, head-like, 1–3 spikes; involucre bracts 2–3, leaf-like, linear, plicate, 0.5–3.5 cm by 0.5 mm, glabrous, apex acute, margin entire. **Spikes** ovoid, 3–4 by 2.5–3 mm; axis glabrous. **Spikelets** sessile, narrowly oblong, 1.5–2 by 0.25 mm, subtended by a glume-like spikelet bracts. **Spikelets bract** yellowish brown to brown, elliptic-oblong, 1.5–2 by 0.25 mm, membranous, glabrous, apex caudate, recurved, margin entire, keel green. **Glumes** 2 per spikelet, 2-ranked, 1-flowered, yellowish brown to brown, narrowly oblong, ca 1.25 by 0.25 mm, membranous, glabrous, apex obtuse, margin entire, keel pale brown. **Flowers** bisexual. **Perianth segment** absent. **Stamens** 1–2, free; filaments ca 0.5 mm long, glabrous; anthers basifixed, 2-celled, ca 0.5 mm long, glabrous. **Ovary** superior, ca 1 mm long, glabrous; style 1, continuous with ovary, ca 0.25 mm long, glabrous; stigma 2–3, filiform, ca 0.25 mm long, glabrous. **Fruit** a nutlet, reddish brown, linear-oblong, trigonous, ca 1.25 by 0.25 mm, pitted.

**Thailand.**— NORTH-EASTERN: Maha Sarakham; SOUTH-EASTERN: Prachinburi; PENINSULAR: Trang.

**Distribution.**— Japan, South Korea, Taiwan, South China, Myanmar, Malesia and Australia.

**Ecology.**— On rather dry-open areas, roadsides, seasonally flooded areas and margin of rice fields. More abundant during dry season, disappear during flood season.

**Vernacular.**— Kok kap pra noi (กกกาบประนี้อย) (Northeastern).

**Specimen examined.**— *P. Pattarakulpisutti et al.* 480 (PSU).

**100. *Pycneus flavidus*** (Retz.), T. Koyama, J. Jap. Bot. 51(10): 316 .1976; D. A. Simpson & T. Koyama in Fl. Thailand. 6(4): 393. 1998.— *Cyperus flavidus* Retz., Observ. Bot. 5: 13. 1788; Kern in Fl. Males., Ser. 1, Spermat. 7(3): 648. 1974.— *P. capillaris* (Roxb.) Nees ex C. B. Clarke in Fl. Brit. India (J. D. Hooker) 6: 591. 1893.

Annual or perennial herb; culm tufted, 8–21 by 0.1 cm, trigonous, glabrous. **Leaves** distichous, few per culm; sheath closed, 3–6 cm long, glabrous; ligule absent; blade linear, plicate, up to 70 by 1–2 mm, chartaceous, glabrous, apex gradually narrowed, margin serrulate. **Inflorescences** terminal, umbel-like, simple; primary branches 5–20 mm long, glabrous; involucre bracts 3, leaf-like, linear, plicate, 6–50 by 1–2 mm, glabrous, apex gradually narrowed, margin entire. **Spikelets** linear-oblong, 3–16 by 2–3 mm, glabrous. **Glumes** 11–20 per spikelet, 2-ranked, all fertile, dark brown, oblong-ovate, 1.5–2 by 1–1.5 mm, membranous, glabrous, apex obtuse, margin entire, keel green. **Flowers** bisexual. **Perianth segment** absent. **Stamens** 2, free; filaments ca 0.5 mm long, glabrous; anthers basifixed, 2-celled, ca 0.5 mm long. **Ovary** superior, ca 0.5 mm long, glabrous; style 1, continuous with ovary, ca 1 mm long, glabrous; stigma 2, filiform, ca 1 mm long, glabrous. **Fruit** a nutlet, dark brown, broadly obovate, biconvex, ca 1 by 1 mm, punctate.

**Thailand.**— NORTHERN: Mae Hong Son, Chiang Mai, Nan, Phrae, Tak; NORTH-EASTERN: Loei, Sakon Nakhon, Nakhon Phanom; SOUTH-WESTERN: Kanchanaburi; Peninsular: Trang.

**Distribution.**— Old World tropics and temperate regions.

**Ecology.**— Scattering in rather dry-open areas and seasonally flooded areas. More abundant in dry season, disappear in flood season.

**Vernacular.**—

**Specimen examined.**— *P. Pattarakulpisutti et al.* 483(PSU).

**101. *Pycnus polystachyos*** (Rottb.) P. Beauv., Fl. Oware 2: 48 (t. 86). 1816; C. B. Clarke in Fl. Brit. India (J. D. Hooker) 6: 592. 1893; Ridl., Fl. Malay. Penin. 5: 139. 1925; D. A. Simpson & T. Koyama in Fl. Thailand. 6(4): 394. 1998.— *Cyperus polystachyos* Rottb., Descr. Pl. Rar. 21. 1772; Kern in Fl. Males., Ser. 1, Spermat. 7(3): 649. 1974.

Annual or perennial herb; culm densely tufted, 35–42 by 0.1–0.2 cm, terete, glabrous. **Leaves** distichous, few per culm; sheath closed, 1–3 cm long, glabrous; ligule absent; blade linear, plicate, 2–20 by 0.2–0.3 cm, chartaceous, glabrous, apex gradually narrowed, margin entire. **Inflorescences** terminal, umbel-like, simple; primary branches 0.6–5.5 cm long, glabrous; involucral bracts 5–7, leaf-like, linear, plicate, 1.2–12 by 0.5–3 cm, glabrous, apex gradually narrowed, margin entire to serrulate. **Spikelets** in digitately clusters, linear-oblong, 1–1.5 by 0.1–0.2 cm, glabrous. **Glumes** 13–20, 2-ranked, all fertile, yellowish brown, oblong-ovate to ovate-elliptic, 2–2.5 by 1.5–2 mm, membranous, glabrous, apex acute, margin entire, keel green. **Flowers** bisexual. **Perianth segment** absent. **Stamens** 2, free; filaments ca 0.25 mm long, glabrous; anthers basifixed, 2-celled, ca 0.5 mm long. **Ovary** superior, ca 0.5 mm long, glabrous; style 1, continuous with ovary, 1–1.25 mm long, glabrous; stigma 2, filiform, 1.5–2 mm long, glabrous. **Fruit** a nutlet, dark brown, oblanceolate, biconvex, ca 1–1.25 by 1 mm, punctate.

**Thailand.**— Throughout Thailand.

**Distribution.**— Tropics, subtropics and warm temperate region.

**Ecology.**— Scattering in rather dry-open areas and seasonally flooded areas. More abundant during dry season, disappear during flood season.

**Vernacular.**— Kok khee-maa (กกขี้หมา), Phraek saai (แพรงไทร)  
(Peninsular).

**Specimen examined.**— *P. Pattarakulpisutti et al.* 492 (PSU).

**102. *Rhynchospora corymbosa*** (L.) Britton, Trans. New York Acad. Sci. 11: 84. 1892; Kern in Fl. Males., Ser. 1, Spermat. 7(3): 713. 1974; D. A. Simpson & T. Koyama in Fl. Thailand. 6(4): 411, pl. XXX1. 1998.— *R. aurea* Vahl, Enum. Pl. (Vahl) 2. 229. 1805; C. B. Clarke in Fl. Brit. India (J. D. Hooker) 6: 670. 1893; Ridl., Fl. Malay. Penin. 5: 164. 1925.

Perennial herb; culm densely tufted, 90–108 by 0.3–1 cm, trigonous, glabrous. **Leaves** distichous, several; basal sheath closed, up to 20 cm long, glabrous; culine sheath closed 6–8 cm long, glabrous; ligule absent; blade linear, plicate, 8–66 by 0.5–1.2 cm, chartaceous, glabrous, apex gradually narrowed, margin serrulate. **Inflorescences** terminal, panicle-like, comprising of 3–5 partial inflorescences; each partial inflorescence corymbiform, simple to compound; primary branches 2–14 cm long, scabrous; secondary branches up to 5 cm long, scabrous; involucre bracts 2–3, leaf-like, linear, plicate, 3–20 by 0.4–0.6 cm, glabrous, apex gradually narrowed, margin scabrous. **Spikelets** in digitately clusters, narrowly lanceolate to lanceolate, 6–8 by 1–3 mm, glabrous. **Glumes** 5–7 per spikelet, 2-ranked, 2–3-flowered, reddish brown, oblong-ovate, 2.5–5 by 1.5–3 mm, membranous, glabrous, apex acute to mucronate, margin entire, keel brown. **Flowers** lowest bisexual and 1–2 upper ones staminate. **Perianth segments** in bisexual flower 6, persistent, filiform, 4–5 mm long, with bristles along margin. **Stamens** 3, free; filaments ca 0.25 mm long, glabrous; anthers basifixed, 2-celled, 2.5–3 mm long. **Ovary** superior, ca 3 mm long, glabrous; style 1, continuous with ovary, persistent, ca 3 mm long, glabrous; stigma shortly bilobed. **Fruit** a nutlet, dark brown, oval, biconvex, ca 4 by 3 mm, punctate; style base conical, ca 3 mm long, glabrous.

**Thailand.**— EASTERN: Chaiyaphum; Nakhon Ratchasima; CENTRAL: Nakhon Nayok, Nonthaburi, Bangkok; SOUTH-EASTERN: Prachin Buri, Chon Buri, Chanthaburi, Trat; PENINSULAR: Ranong, Phangnga, Krabi, Trang, Satun, Narathiwat.

**Distribution.**— Pantropics.

**Ecology.**— Scattering in marshlands and rice fields. Flowering and fruiting all year round.

**Vernacular.**— Yaa bai khom (หญ้าไบบคม) (Central); Yaa khom bang (หญ้าคบบาง), Yaa tham hong (หญ้าท่าหง) (Peninsular).

**Specimens examined.**— *P. Pattarakulpisutti et al.* 402, 421 (PSU).

**103. *Rhynchospora rubra*** (Lour.) Makino, Bot. Mag. (Tokyo) 17: 180. 1903; Kern in Fl. Males., Ser. 1, Spermat. 7(3): 717, fig. 99–100. 1974; D. A. Simpson & T. Koyama in Fl. Thailand. 6(4): 416. 1998.— *R. wallichiana* Kunth, Enum. Pl. (Kunth) 2: 289. 1837; C. B. Clarke in Fl. Brit. India (J. D. Hooker) 6: 668. 1894; Ridl., Fl. Malay. Penin. 5: 164. 1925.

Annual or perennial herb; culm densely tufted, 54–73 by 0.1 cm, subterete, glabrous. **Leaves** basal, several; sheath closed, up to 12 cm long, glabrous; ligule absent; blade linear, plicate, 2–25 by 1.5–2 cm, chartaceous, glabrous, apex gradually narrowed, margin serrulate. **Inflorescences** terminal, head-like; involucre bracts 5–7, leaf-like, linear, plicate, 0.7–35 by 0.1–0.2 cm, glabrous, apex gradually narrowed, margin serrulate. **Spikelets** narrowly lanceolate to lanceolate, 2–6 by 1–1.5 mm, glabrous. **Glumes** 6–8 per spikelet, 2-ranked, the 2–3 basal glumes empty, reddish brown, ovate to lanceolate, 1.5–5 by 1–1.5 mm, membranous, glabrous, apex acute, margin entire, keel brown. **Flowers** lowest bisexual and 1–2 upper ones staminate. **Perianth segments** 6, persistent, filiform, 1–1.25 mm long, with bristles along margin. **Stamens** 3, free; filament not seen; anthers basifixed, 2-celled, 2–3 mm long. **Ovary** superior, ca 1 mm long, glabrous; style 1, continuous with ovary, persistent, ca 2.5–3 mm long, undivided, glabrous. **Fruit** a nutlet, dark brown, obovoid, biconvex, 1.5–2 by 1 mm, glabrous; style conical, 0.25–0.5 mm long, glabrous. **Plate 12.E.**

**Thailand.**— NORTHERN: Mae Hong Son, Chiang Mai, Chiang Rai, Lamphun, Tak, Phitsanulok; NORTH-EASTERN: Loei, Nong Khai; EASTERN:

Chaityaphum, Roi Et; SOUTH-WESTERN: Kanchanaburi, SOUTH-EASTERN: Prachin Buri, Chon Buri, Chanthaburi, Trat; PENINSULAR: Chumphon, Surat Thani, Krabi, Phattalung, Trang, Songkhla, Pattani, Satun.

**Distribution.**— India to Vietnam, South China, Japan, Malesia to Australia and Pacific Islands.

**Ecology.**— Scattering on rather dry-open areas and seasonally flooded areas. More abundant during dry season, disappear during flood season.

**Vernacular.**— Ya hua daeng (หญ้าหัวแดง) (Narathiwat, Trat).

**Specimen examined.**— *P. Pattarakulpisutti et al.* 459 (PSU).

**104. *Scleria poiformis*** Retz., *Observ. Bot. (Retzius)* 4. 13. 1786; Kern in *Fl. Males.*, Ser. 1, *Spermat.* 7(3): 736, fig. 108. 1974; D. A. Simpson & T. Koyama in *Fl. Thailand.* 6(4): 439. 1998.— *S. oryzoides* J.Presl & C.Presl, *Reliq. Haenk* 1(3): 201. 1828; C. B. Clarke in *Fl. Brit. India (J. D. Hooker)* 6: 691. 1894; Ridl., *Fl. Malay. Penin.* 5: 177. 1925.

Perennial herb; culm solitary, 126–156 by 1–2 cm, trigonous, glabrous. **Leaves** distichous, several; sheath closed, up to 15 cm long, glabrous; blade linear, plicate, 20–93 by 1–1.6 cm, chartaceous, glabrous, apex subacute, margin entire. **Inflorescences** terminal, panicle-like, comprising of several partial inflorescences; involucre bracts absent or 1–2, glume-like, narrowly deltoid, ca 2 by 1 mm, glabrous, apex acute, margin entire. **Spikelets** solitary, unisexual; nutlet-bearing spikelets on the base of partial inflorescences, narrowly lanceolate, ca 5 by 1 mm, glabrous; male spikelets ovate, ca 4 by 2 mm. **Glumes** 5–7 per spikelet, spirally arranged, the 2–3 basal glumes empty, brown, broadly ovate, 1–4 by 0.8–2 mm, membranous, glabrous, apex acute, margin entire, keel brown. **Flowers** unisexual. **Perianth segment** absent. **Stamens** 3, free, sessile; anthers basifixed, 2-celled, 2–3 mm long, glabrous. **Ovary** superior, ca 1.5 mm long, glabrous; style continuous with ovary, 2–3 mm long, glabrous; stigma 3, filiform, 3–5 mm long, glabrous. **Fruit** a nutlet, shiny white, oval,

indistinct trigonous, ca 2.5–3 by 2 mm, glabrous; disk obtusely deltoid, ca 0.5 mm long. *Plate 12.D.*

**Thailand.**— NORTHERN: Chiang Mai, Kamphaeng Phet, Nakhon Sawan; EASTERN: Chaiyaphum, Nakhon Ratchasima, Roi Et; SOUTH-EASTERN: Chanthaburi; CENTRAL: Phra Nakhon Si Ayutthaya; PENINSULAR: Chunphon, Surat Thani, Trang, Songkhla, Narathiwat.

**Distribution.**— Tropical Africa through India and Sri Lanka eastward to Southeastern China and Northern Australia.

**Ecology.**— Weeds in abandoned rice fields and in marshland which subjected to annual flood, usually growing in large communities.

**Vernacular.**— Prue (ปรี้อ) (General); Waeng (แวง) (Eastern); Prue naa (ปรี้อนา) (Peninsular).

**Specimens examined.**— *P. Pattarakulpisutti et al.* 267; *J.F. Maxwell* 84–446; J.-Supapol 232 (PSU).

## ERIOCAULACEAE

**105. *Eriocaulon glabriflorum*** Ridl., J. Fed. Malay States Mus. 10: 155. 1920; Ridl., Fl. Malay. Penin. 5: 135. 1967.

Annual herb with erect tufted of leaves, 8–14 cm high; monoecious. **Leaves** simple, basal; blade linear, 3.5–7 by 0.2–0.7 cm, fleshy, glabrous, apex acute, margin entire. **Inflorescences** basal, head, 2–5 mm in diam.; scape 3.5–12 cm long, glabrous; involucre bracts obovate-oblong, 2–2.5 by 1.5–2 cm, glabrous, apex acute, margin entire. **Flowers** unisexual, actinomorphic; floral bracts obovate, ca 1.25 by 0.75 mm, glabrous, apex acute, margin entire. **Staminate flowers** ca 0.5 mm in diam.; pedicels ca 0.5 mm long, glabrous; calyx white, free, sepals 3, spatulate, ca 0.5 by 0.25 mm, glabrous, apex obtuse, margin entire; corolla white, free, petals 3, deltoid, ca 0.25 by 0.25 mm, glabrous, apex acute, margin entire. **Stamens** 4, free; filaments ca 0.25 mm long, glabrous; anthers 2-celled, basifixed, ca 0.25 mm long, glabrous.

**Pistillate flowers** ca 0.25 mm in diam.; calyx white, free, sepals 2, narrowly oblanceolate, 1–1.25 by 0.25 mm, glabrous, apex obtuse, margin entire; corolla white with black tip, free, petals 3, narrowly lanceolate, 1.25–1.5 by 0.25 mm, glabrous, apex obtuse, margin entire. **Ovary** superior, ca 0.75 by 0.5 mm, placentation axile, 3-loculed; style 1, very short, glabrous; stigma 3, filiform, ca 1 mm long. **Fruit** and **Seed** not seen.

**Thailand.**— PENNINSULAR: Krabi, Trang, Satun, Songkhla.

**Distribution.**— Peninsular Malaysia.

**Ecology.**— In old rice fields, more abundant during flood season, disappear during dry season.

**Vernacular.**—

**Specimens examined.**—*P. Pattarakulpisutti et al.* 481 (PSU); *J.F. Maxwell* 84–42, 85–738 (PSU).

**106. *Eriocaulon xeranthemum*** Mart., Pl. Asiat. Rar. (Wallich). 3: 29. 1832; Ridl., Fl. Malay. Penin. 5: 135. 1967.

Annual herb with erect tufted of leaves, 4–5 cm high; monoecious. **Leaves** simple, basal; blade linear, 15–20 by 3–4 mm, fleshy, glabrous, apex acute, margin entire. **Inflorescences** basal, head, 3–4 mm in diam., composed of pistillate flowers on outer rings and staminate flowers in inner rings; scape 1.2–1.7 cm long, glabrous; involucral bracts lanceolate to linear-lanceolate, 3–4 by 1 mm, glabrous, apex acuminate, margin serrate. **Flowers** unisexual, actinomorphic; floral bracts oblanceolate, 1.25–1.5 by 0.5 mm, glabrous, apex obtuse, margin entire. **Staminate flowers** ca 0.5 mm in diam., sessile; calyx not seen; corolla white, free, sepals 3, spatulate, ca 1 by 0.5 mm, glabrous, apex obtuse, margin entire. **Stamens** 6, free; filaments ca 0.25 mm long, glabrous; anthers 4-celled, basifixed, ca 0.25 mm long, glabrous. **Pistillate flowers** ca 0.5 mm in diam.; calyx white, free, sepals 3, filiform, ca 1 mm long, glabrous; corolla white with black tip, free, petals 3, lanceolate, ca 1 by 0.25 mm, glabrous, apex obtuse, margin entire. **Ovary** superior, ca 0.5 by 1 mm,



placentation axile, 3-loculed; style 1, ca 0.5 mm long, glabrous; stigma 3, filiform, ca 0.25 mm long, glabrous. **Fruit** a capsule, ellipsoid, ca 0.5 by 0.25 mm, glabrous. **Seeds** not seen.

**Thailand.**— PENNINSULAR: Trang.

**Distribution.**— India, Peninsular Malaysia, Africa.

**Ecology.**— In old rice fields, more abundant in flood season, disappear in dry season.

**Vernacular.**—

**Specimen examined.**—*P. Pattarakulpisutti et al.* 499 (PSU).

#### FLAGELLARIACEAE

**107. *Flagellaria indica*** L., Sp. Pl. 1: 333. 1753; Ridl., Fl. Malay Penins. 4: 368. 1924; K. Larsen in Fl. Thailand 2(2): 162. 1972.

Vine; stem 3–4 mm in diam., glabrous. **Leaves** simple, distichous; sessile; sheath closed, 1.5–2.5 cm long; blade linear-lanceolate, 7–16 by 0.4–1.5 cm, coriaceous, glabrous, apex gradually narrowed to coiled tendril, margin entire. **Inflorescences** terminal, panicle, usually composed of 2 main branches, each branch 2.5–3.3 cm long, glabrous; peduncle 7–17 mm long, glabrous. **Flowers** actinomorphic, 3–5 mm in diam., sessile; bracts deltoid, ca 1 by 1 mm, glabrous, apex acute, margin entire. **Perianth** white, connate with very short tube, persistent, 6-lobed, glabrous; tube ca 1 by 1.5 mm; lobes unequal in two series; outer ones oblong, ca 2 by 2 mm, apex obtuse, margin entire; inner ones lanceolate-oblong, 2.5–3 by 1 mm, apex obtuse, margin entire. **Stamens** 6, free; filaments 4–6 mm long, glabrous; anther not seen. **Ovary** superior, 1–2 by 1 mm, glabrous, placentation axile, 3-loculed; style short; stigma 3, plumose, up to 2 mm long, glabrous. **Fruit** a drupe, green, subglobose, ca 5 by 3.5 mm, glabrous. **Seed** not seen. **Plate 12.F.**

**Thailand.**— From Central, South-Eastern, South Western to Peninsular Thailand.

**Distribution.**— Sri Lanka, Indochina, Malaysia, Melanesia and Polynesia to Northern Australia.

**Ecology.**— Common in mangroves, thickets along river, fresh water-swamp forests and peat swamp forests. Flowering and fruiting all year round.

**Vernacular.**— Wai yep chak (หวายเข็ญจาก), Wai ling (หวายลิง), Wai li (หวายลี่) (Peninsular)

**Specimens examined.**— *P. Pattarakulpisutti et al.* 226, 277, 360 (PSU).

## LILIACEAE

**108. *Gloriosa superba*** L., Sp. Pl. 1: 305. 1753; Ridl., Fl. Malay Penins. 4: 338. 1924; Backer & Bakh. f., Fl. Java (Spermatoph.) 3: 85. 1968; Jossop in Fl. Males., Ser. 1, Spermat. 9(1): 193, fig. 1–2. 1979.

Rhizomatous vine; rhizome short in V shape; aerial stem annual, up to 2 m by 2–4 mm, glabrous. **Leaves** simple, alternate; sessile; blade narrowly lanceolate, 5.5–14 by 1.1–2.8 cm, membranous, glabrous, apex gradually narrowed to coiled tendril, margin entire. **Flowers** solitary, opposite to leaves, actinomorphic, 3–5 cm in diam.; peduncle 2–10 cm long, glabrous. **Perianth** yellow with orange to red patch on upper part, free, 5-lobed, narrowly elliptic, 5–6 by 0.6–0.7 cm, glabrous, apex acuminate, margin undulate, base cuneate. **Stamens** 6, free; filaments ca 4 cm long, glabrous; anthers versatile, 2-celled, 8–10 mm long, glabrous. **Ovary** superior, 8–9 by 3 mm, glabrous, placentation axile, 3-loculed; style 1, 3.5–4 cm long, glabrous; stigma 3, filiform, 2–4 mm long, glabrous. **Fruit** a capsule, green, ellipsoid, 5–5.5 by 1.8–2 cm, glabrous. **Seeds** not seen. **Plate 13.A.**

**Thailand.**— Throughout Thailand.

**Distribution.**— Tropical and Southern Africa, Madagascar, India to Indochina, Peninsular Malaysia, Java.

**Ecology.**— In secondary vegetations, open thickets along rivers and coastal sand dune vegetations. Flowering and fruiting all year round.

**Vernacular.**— Kam pu (กำมปู) (Chai Nat); Khom khwan (คมขวาน), Bong khwan (บ้องขวาน), Hua khwan (หัวขวาน) (Chon Buri); Dong dueng (ดองดึง) (General); Dao dueng (ดาวดึงส์), Wan kam pu (ว่านกำมปู) (Central); Phan maha (พันมหา) (Nakhon Ratchasima); Ma kha kong (มะหาโคง) (Northern); Moi hi ya (หมอยหีย่า) (Udon Thani).

**Specimens examined.**—*P. Pattarakulpisutti et al.* 378, 430 (PSU).

## MARANTACEAE

**109. *Schumannianthus dichotomus*** Gagnep., Bull. Soc. Bot. France 51: 176. 1904; Suksathan & Borchs. in Fl. Thailand. 9(2): 135, fig. 2e-g, pl. XIII2. 2008.

Semi-herbaceous shrub; rhizome not seen; aerial stem up to 2 m high, branched, glabrous. **Leaves** simple, distichous; petiole sheathing, 6–9 cm by 5–10 mm, sparsely hairy; pulvinus 5–8 by 2 mm, hairy; blade elliptic to elliptic oblong, 8.5–12 by 3.5–5 cm, chartaceous, glabrous, apex acuminate, margin entire, base cuneate. **Inflorescences** terminal, spiciform, composed of 7–14-internodes, each node with a special paraclade; peduncle 5–7.8 cm long, glabrous; rachis 7–22 cm long, glabrous; special paraclade comprise of 2-flowered, each subtended by bracts; bracts linear, 3–5 by 6–7 mm, glabrous, apex acute, margin inrolled. **Flowers** zygomorphic, 3–4 cm in diam.; pedicels ca 1.5 mm long, hairy; bracteoles ellipsoid, 2–2.5 by 1 mm, fleshy, glabrous, apex obtuse, margin entire. **Calyx** petaloid, white, free, sepals 3, narrowly deltoid, 5–6 by 2 mm, glabrous, apex acuminate, margin entire. **Corolla** white, gamopetalous, salverform, 3-lobed, glabrous; tube ca 10 by 2 mm; lobes linear-oblong, 2–2.2 by 4–5 mm, apex acute, margin entire. **Staminodes** petaloid, white, connate, 4-lobed in 2 wholes, glabrous; tube 24–28 by 2.2 mm; outer lobes 2, obovate in outline, 1.8–2 by 1–1.7 cm, apex obtuse, margin entire; cucullate staminode-lobe hooded, ca 4 by 5 mm, apex obtuse, margin entire; callose staminode-lobed broadly ovate, ca 6 by 8 mm, apex emarginate, margin entire. **Stamen** 1, adnate with staminode tube up to three-fourths of filament length; free part of filament ca 3 mm

long, glabrous; petaloid appendage spatulate, ca 3 by 2 mm, glabrous, apex acute, margin entire; anthers basifixed, 2-celled, ca 2 mm long, glabrous. **Ovary** inferior, ca 1.5 mm in diam., hairy, placentation axile, 3-loculed; style 1 adnate with staminode tube, 2.7–3 cm long, glabrous; stigma 2, flattened, ca 1 mm long, glabrous. **Fruit** a berry reddish green, sub-globose with 3-blunt angled, 8–10 mm in diam., sparsely hairy. **Seeds** not seen. **Plate 13.B.**

**Thailand.**— Throughout Thailand.

**Distribution.**— Myanmar, Indochina, Peninsular Malaysia and Borneo.

**Ecology.**— Usually forming thickets in open marsh areas and seasonally flooded areas. Flowering and fruiting all year round.

**Vernacular.**— Yhang (แห่ย่ง) (Northern); Kan phra (ก้านพริ้ว) (Central); Bu-mae-chi-cha-ai (บุแมจี้ชะไฉย) (Malay-Pattani); Khla (คล้า) (General).

**Specimen examined.**— *P. Pattarakulpisutti et al.* 169 (PSU).

## ORCHIDACEAE

**110. *Micropera pallida*** (Roxb.) Lindl., Edwards's Bot. Reg. 18: t. 1522. 1832; Seidenf., Opera Bot. 95: 120, fig. 71, pl. XIIb. 1988; Seidenf. & J. J. Wood, Orchids Pen. Mal. & Sing.: 617, fig. 280f-i, pl. 43c. 1992.— *Camarotis apiculata* Rchb. f., Bonplandia 5: 39. 1857; Holttum, Rev. Fl. Malaya 1: 633, fig. 187c-h. 1953; Seidenf. & Smitinand, Orchids Thailand 4: 708, fig. 527. 1965; Backer & Bakh. f., Fl. Java (Spermatoph.) 3: 440. 1968.— *Sarcohilus roxburghii* Hook. f., Fl. Brit. India (J. D. Hooker) 6: 36. 1890.

Epiphytic orchid, monopodial; stem glabrous, internodes 2–2.5 by 0.4 cm; aerial roots ca 2–3 mm in diam. **Leaves** distichous, linear-oblong, 5–7.5 by 0.7–1 cm, succulent, glabrous, apex emarginate, margin entire, base sheathing. **Inflorescences** lateral, spike, pendent, 12–20-flowered; peduncle 1.2–3 cm long, glabrous; rachis 3–5.5 cm long, glabrous; sterile bracts deltoid, ca 3 by 2 mm,

glabrous, apex sub-acute, margin entire. *Flowers* zygomorphic, ca 1.5 cm in diam.; pedicels 7–8 mm long, glabrous. *Sepals* yellow with median purple streak on the back, glabrous; dorsal sepal ovate-elliptic, 5–6 by 2–3 mm, apex acute, margin entire; lateral sepals oblanceolate-oblong, 4–5 by 3 mm, apex obtuse, margin entire. *Lateral petals* yellow, lanceolate-oblong, ca 4 by 2 mm, glabrous, apex acuminate, margin entire. *Lip* yellow, ovate-lanceolate, 6–7 by 3–4 mm, 3-lobed, glabrous; spur 4–5 by 3 mm, apex obtuse; midlobe deltoid, ca 1 by 1 mm, apex acute, margin entire, base with fleshy ridges; side lobes quadrangular, ca 2 by 2 mm, erect, apex truncate, margin entire. *Column* yellow, ca 2 mm long; operculum reniform, ca 1 by 2 mm. *Pollinia* 2; stipe ca 3 mm long; vicidium very small. *Fruit* a capsule, slender, 4.6–5.5 by 0.2–0.3 cm, glabrous. **Plate 13.C.**

**Thailand.**— NORTHERN: Kamphaeng Phet, Nakhon sawan; SOUTH-WESTERN: Prachuap Khiri Khan; SOUTH-EASTERN: Prachinburi, Chanthaburi; PENINSULAR: Surat Thani, Nakhon Si Thammarat, Trang, Songkhla.

**Distribution.**— Northeastern India, Indochina, Sumatra, Java, Borneo, Peninsular Malaysia.

**Ecology.**— Epiphytes on trees and shrubs in floodplain vegetation, usually occurring in high abundance. Flowering and fruiting from June to September.

**Vernacular.**— Wai khem (หวายเข็ม) (Narathiwat); Ueang ma laeng po thong (เอื้องแมลงปอทอง) (General).

**Specimens examined.**— *P. Pattarakulpisutti et al.* 385, 392 (PSU).

**111. *Thrixspermum leucarachne*** Ridl., J. Linn. Soc., Bot. 32: 397. 1986; Ridl., Fl. Malay. Penin. 4: 186. 1924; Holttum, Rev. Fl. Malaya 1: 601. 1953; Seidenf. & Smitinand, Orchids Thailand 4: 519. 1963; Seidenf. & Smitinand, Orchids Thailand 4: 819, fig. 615. 1965; Seidenf., Opera Bot. 95: 150, fig. 91. 1988; Seidenf. & J. J. Wood, Orchids Pen. Mal. & Sing.: 641. Fig. 290g-i. 1992.

Epiphytic orchid, monopodial; stem glabrous, internodes 6–11 by 4–7 mm; aerial roots ca 1–1.5 mm in diam. *Leaves* distichous, linear-oblong, 4.8–14 by

1.3–2.1 cm, succulent, glabrous, apex obliquely emarginate, margin entire, base sheathing. **Inflorescences** lateral, spike, 5–20-flowered; peduncle 6.5–15 cm long, glabrous; rachis 2.5–9.5 cm long, glabrous; sterile bracts deltoid, ca 2 by 2 mm, glabrous, acute, margin entire. **Flowers** zygomorphic, 6–8 cm in diam.; pedicels 5–15 mm long, glabrous. **Sepals** white, glabrous; dorsal sepal linear-filiform, 3–7 by 0.2–0.3 cm, apex acuminate, margin entire; lateral sepals linear-filiform, 3–7 by 0.2 cm, apex acuminate, margin entire. **Lateral petals** white, linear-filiform, 3–6.5 by 0.2 cm, glabrous, apex acuminate, margin entire. **Lip** white with purple spots on side lobes and at base of midlobe, narrowly deltoid, fleshy, 0.5–1 by 0.25–4 cm, 3-lobed, hairy at base and inner side of spur; spur ca 5 by 3 mm, apex obtuse; midlobe narrowly deltoid, 3–7 by 0.2–0.3 cm, apex obtuse, margin entire, base with fleshy lobe; side lobes oblong, 2–3 by 1 mm, erect, apex obtuse, margin entire. **Column** white, 1–2 mm long; operculum not seen. **Pollinia** not seen. **Fruit** not seen. **Plate 13.D.**

**Thailand.**— NORTH-EASTERN; Sakon Nakhon; PENINSULAR: Nakhon Si Thammarat, Trang.

**Distribution.**— Peninsular Thailand.

**Ecology.**— Epiphytes on trees in floodplain vegetations, occurring in low abundance. Flowering from May to October, fruiting from August to October.

**Vernacular.**— Ueang maeng mai (เอื้องแมงไหม) (General).

**Specimens examined.**— *P. Pattarakulpisutti et al.* 193, 246.

## POACEAE

**112. *Cynodon dactylon*** (L.) Pers., Syn. Pl. (Persoon) 1: 85. 1805; Ridl., Fl. Malay. Penin. 5: 249. 1925; Holttum, Rev. Fl. Malaya 3: 90, fig. 14, pl. 15c. 1971.

Annual herb; culm 8–14 by 0.1 cm, glabrous. **Leaves** distichous; sheath open, 1–3 cm long, glabrous; ligule a rim of short hairs, ca 0.25 cm long; blade linear-lanceolate, 2–4.4 by 0.2–0.4 cm, sub-chartaceous, glabrous, apex acuminate, margin scabrous. **Inflorescences** terminal, composed of 4–6 spikes in digitately arranged;

peduncle 5.5–7.5 cm long, glabrous; spikes 2.5–4.5 cm long; rachis of spike scabrous. **Spikelets** solitary, alternately arranged on inner side of rachis, sub-sessile, lanceolate, 1.5–2 by 0.75–1 mm; 1-flowered, floret bisexual; lower glume narrowly deltoid, ca 0.5 by 0.25 mm, membranous, glabrous, apex acute, margin scabrous; upper glume narrowly lanceolate, ca 0.75 by 0.25 mm, membranous, glabrous, apex acuminate, margin entire; lemma broadly ovate when flattened, ca 2 by 2 mm, membranous, glabrous, apex obtuse, margin ciliate; palea narrowly oblong, ca 2 by 0.5 mm, hyaline, glabrous, apex acuminate, margin entire. **Stamens** 3, free; filaments ca 0.25 mm, glabrous; anthers basifixed, 2-celled, ca 0.25 mm long, glabrous. **Ovary** superior, ca 0.25 mm long, glabrous; style and stigma not seen. **Fruit** a grain, oblanceolate, reddish brown, flattened, ca 1 by 0.5 mm, glabrous.

**Thailand.**— PENINSULAR: Surat Thani, Trang, Nakhon Si Thammarat, Songkhla.

**Distribution.**— Pantropics.

**Ecology.**— Very common in open areas, usually on dry areas, roadsides, waysides and periodic flooded areas. More abundant during dry period, disappear during flood period.

**Vernacular.**— Ya phaet (หญ้าแพต) (Northern); Ya phraek (หญ้าแพรก) (Central); No-ke-de (หน่อไก่เด) (Karen-Mae Hong Son).

**Specimen examined.**— *P. Pattarakulpisutti et al.* 489 (PSU).

**113. *Echinochloa colona*** (L.) Link, Hort. Berol. (Link) 2: 209. 1833; Ridl., Fl. Malay. Penin. 5: 222. 1925; Holttum, Rev. Fl. Malaya 3: 167, color pl. 10, pl. 21a. 1971.

Annual herb; culm 13–33 by 0.1 cm, glabrous. **Leaves** distichous; sheath open, 1.5–5.8 cm long, covered with long hairs along margin; ligule absent; blade linear-lanceolate to linear, 2–12 by 0.3–0.5 cm, sub-chartaceous, glabrous, apex acuminate, margin entire to scabrous. **Inflorescences** terminal, panicle, composed of

4–5 racemes; peduncle up to 7.5 cm long, glabrous; rachis 4.8–6 cm long, glabrous; raceme 0.7–1.5 cm long; rachis of spike scabrous. *Spikelets* solitary, appear in two rows on inner side of rachis, sub-sessile, lanceolate-obovate, ca 2 by 1 mm; lower flower absent; lower glume broadly deltoid, 1–1.25 by 0.5–1 mm, membranous, sparsely hairy, apex acuminate, margin ciliolate; upper glume broadly elliptic, ca 2 by 1 mm, membranous, sparsely hairy, apex acuminate, margin ciliolate; lower lemma lanceolate-obovate, ca 1.5 by 1 mm, membranous, sparsely hairy, apex acuminate, margin ciliolate; lower palea lanceolate-ovate, ca 1 by 0.75 mm, hyaline, glabrous, apex acute, margin ciliolate; upper florets bisexual; upper lemma broadly elliptic, 1.5–2 by 1 mm, indurated, glabrous, apex acuminate, margin inrolled; upper palea elliptic ovate, 1–1.5 by 0.75 mm, indurated, glabrous, apex acuminate, margin entire. *Stamens* 3, free; filaments ca 0.25 mm, glabrous; anthers basifixed, 2-celled, 0.5–0.75 mm long, glabrous. *Ovary* superior, ca 0.25 mm long, glabrous; styles 2, ca 1 mm long; stigma 2, plumose, ca 0.5 mm long. *Fruit* not seen. **Plate 13.E.**

**Thailand.**— PENINSULAR: Chumphon, Songkhla.

**Distribution.**— Africa, India, Myanmar and Peninsular Malaysia.

**Ecology.**— Scattering in periodic flooded areas, on shallow water and rice fields, more abundant during flood period, disappear during dry period.

**Vernacular.**— Ya kap kae (หญ้ากำแค) (Bangkok); Ya khao nok (หญ้าข้าวนก) (Suphan Buri, Kanchanaburi); Yan ok khao (หญ้าอันกเขา) (Nakhon Ratchasima); Yap long nok (หญ้าปล้องนก) (Chiang Mai).

**Specimen examined.**— *P. Pattarakulpisutti et al.* 450 (PSU).

#### 114. *Eragrostis* sp.

Annual herb; culm up to 100 by 0.1–0.2 cm, glabrous. *Leaves* distichous; sheaths open, 6–10 cm long, hairy at throat; ligule a rim of short hairs, up to 0.5 mm long; blade linear, 6–30 by 0.2 cm, sub-chartaceous, hairy near base, apex acuminate, margin inrolled. *Inflorescences* terminal, panicle; peduncle 4–15 cm long,



glabrous; rachis 7–19 cm long, glabrous; spikes 4–6.5 cm long; rachis of spike scabrous. **Spikelets** solitary, sessile, narrowly oblong to lanceolate, 3–7 by 1–2 mm, up to 20 florets, bisexual; lower glume narrowly lanceolate, ca 1 by 0.5 mm, membranous, glabrous, apex acute, margin entire; upper glume lanceolate, ca 1 by 0.75 mm, membranous, glabrous, apex acute, margin entire; lemma ovate, 1.25–1.5 by 1 mm, membranous, glabrous, apex acuminate, margin entire; palea oblanceolate in outline, 1.25 by 0.5 mm, hyaline, glabrous, apex acute, margin entire. **Stamens** 3, free; filaments ca 0.5 mm, glabrous; anthers basifixed, 2-celled, ca 0.5–0.75 mm long, glabrous. **Ovary** superior, ca 0.25 mm long, glabrous; styles 2, ca 0.75 mm long; stigma 2, plumose, ca 0.5 mm long. **Fruit** a grain, reddish brown, ellipsoid, ca 0.5 by 0.25 mm, glabrous.

**Thailand.**— PENINSULAR: Trang.

**Distribution.**—

**Ecology.**— In open areas and periodic flooded areas. More abundant during dry period, disappear during flood period.

**Vernacular.**—

**Specimen examined.**— *P. Pattarakulpisutti et al.* 467 (PSU).

**Remarks.**— According to all of the available taxonomic literatures, this these specimens are still unidentified. More literatures are needed to clarify its status.

**115. *Hymenachne acutigluma*** (Steud.) Gilliland, Gard. Bull. Singapore 20: 314. 1964; Holttum, Rev. Fl. Malaya 3: 155, pl. 19a. 1971.— *H. myuros* (Lam.) P. Beauv., Ess. Agrostogr. 165 (49). 1812; Hook. f. in Fl. Brit. India (J. D. Hooker) 7: 39. 1897; Ridl., Fl. Malay. Penin. 5: 230. 1925.

Perennial herb; culm creeping and erect, up to 100 by 0.4–0.6 cm, glabrous. **Leaves** distichous; sheath open, 6.2–10.5 cm long, glabrous; ligule membranous, ca 1 mm long; blade lanceolate-linear to linear, 11–32 by 0.6–1.4 cm,

sub-chartaceous, glabrous to sparsely hairy, apex acuminate, margin scabrous. **Inflorescences** terminal, spike-like panicle; peduncle up to 20 cm long, glabrous; rachis 16.5–45 cm long, glabrous; spikes 1–6 cm long; rachis of spike glabrous. **Spikelets** solitary, narrowly lanceolate, 3.5–4 by 0.7 mm; pedicels up to 1 mm long, scabrous; lower flower absent; lower glume ovate, 0.5–1 by 0.5–0.75 mm, hyaline, glabrous, apex acute, margin entire; upper glume lanceolate, ca 2.5 by 1 mm, membranous, scabrous, apex acuminate, margin entire; lower lemma narrowly lanceolate, 3.5–4 by 1 mm, membranous, scabrous, apex acuminate, margin entire; lower palea absent; upper florets bisexual; upper lemma ovate-lanceolate, ca 3.5 by 1 mm, membranous, sparsely hairy, apex acuminate, margin entire; upper palea ovate-lanceolate, ca 2.5 by 1 mm, hyaline, glabrous, apex acuminate, margin entire. **Stamens** 3, free; filaments ca 0.25 mm, glabrous; anthers basifixed, 2-celled, ca 1 mm long, glabrous. **Ovary** superior, ca 0.25 mm long, glabrous; styles 2, ca 1.5 mm long; stigma 2, plumose, ca 1 mm long. **Fruit** not seen. **Plate 13.F.**

**Thailand.**— Trang, Yala.

**Distribution.**— India, Myanmar, Peninsular Malaysia, Borneo.

**Ecology.**— In seasonally flooded areas and rice fields, usually in large patches. More abundance during flood period, disappear during dry period.

**Vernacular.**— Ya thot plong (หญ้าทอดปล้อง), Ya plong (หญ้าปล้อง) (Bangkok), Rim-pat (ริมป่า), Ka-pai (คัมไป) (Malay-Narathiwat).

**Specimens examined.**— *P. Pattarakulpisutti et al.* 447, 649 (PSU).

**116. *Isachne globosa*** Kuntze, Revis. Gen. Pl. 2: 778. 1891; Holttum, Rev. Fl. Malaya 3: 123, fig. 22, pl. 16c. 1971.— *I. australis* R. Br., Prodr. Fl. Nov. Holland. 1. 196. 1810; Ridl., Fl. Malay. Penin. 5: 239. 1925.

Annual herb; culm creeping and erect, up to 30 by 0.1 cm, glabrous. **Leaves** distichous; sheath open, 1.5–2.5 cm long, with long hairs along margin and throat; ligule a rim of short hairs, up to 1 mm long; blade narrowly lanceolate, 2.7–4

by 0.4–0.8 cm, sub-chartaceous, glabrous, apex acuminate, margin scabrous. **Inflorescences** terminal, panicle; peduncle up to 1.5 cm long, glabrous; rachis 7–10 cm long, glabrous; spikes up to 4 cm long, rachis of spike glabrous **Spikelets** solitary, broadly ellipsoid, 1.5–2 by 1 mm; pedicels up to 7 mm long, glabrous; lower glume ovate-elliptic, ca 1.5 by 0.75 mm, membranous, sparsely hairy, apex obtuse, margin entire; upper glume orbicular, ca 1.25 by 1 mm, membranous, sparsely hairy, apex obtuse, margin entire; lower florets male; lower lemma ovate-elliptic, 1.5–1.7 by 0.75–1 mm, indurated, glabrous, apex obtuse, margin entire; lower palea ovate-elliptic to elliptic, 1.25–1.5 by 0.75 mm, membranous, glabrous, apex obtuse, margin inrolled; upper florets bisexual; upper lemma broadly ovate, ca 1.5 by 1 mm, indurated, glabrous, apex obtuse, margin entire; upper palea broadly ovate, ca 1.25 by 1 mm, indurated, glabrous, apex obtuse, margin inrolled. **Stamens** 3, free; filaments ca 0.25 mm long, glabrous; anthers dorsifixed, 2-celled, 0.5–1 mm long, glabrous. **Ovary** superior, ca 0.25 mm long, glabrous; styles 2, ca 0.25 mm long; stigma 2, plumose, ca 1 mm long. **Fruit** not seen. **Plate 14.C.**

**Thailand.**— PENINSULAR: Chumphon, Trang, Satun, Songkhla, Yala.

**Distribution.**— India, Myanmar, Peninsular Malaysia, Sumatra.

**Ecology.**— Scattering in rather dry areas, roadsides and rice fields, more abundant in dry season, disappear in flood period.

**Vernacular.**— Ya pha rai (หญ้าไร่) (Narathiwat).

**Specimen examined.**— *P. Pattarakulpisutti et al.* 505 (PSU).

**117. *Ischaemum rugosum*** Salisb., Icon. Stirp. Rar. 1, t. 1. 1791; Ridl., Fl. Malay. Penin. 5: 200. 1925; Holttum, Rev. Fl. Malaya 3: 259, fig. 38, pl. 31a-b. 1971.

Annual herb; culm erect, 50–95 by 0.3–0.6 cm, glabrous. **Leaves** distichous; sheath open, 8–9.5 cm long, glabrous; ligule membranous, up to 6 mm long; blade linear, 5.5–17 by 0.5–0.8 cm, sub-chartaceous, glabrous to sparsely hairy,

apex acuminate, margin entire to serrulate. *Inflorescences* terminal, exserted, composed of two diverging racemes; peduncle 3–11.5 cm long, glabrous; racemes 4.5–10 cm long; rachis of racemes trigonous, hairy at internodes. *Spikelets* in pairs, one sessile and one pedicelled. *Sessile spikelets* narrowly oblong to oblong, 3.5–4 by 1.5–2 mm; lower glume narrowly oblong to oblong, 3.5–4 by 1.5–2 mm, indurated, with 4–5 transverse ridges, glabrous, apex obtuse, margin ciliolate on upper part; upper glume narrowly deltoid, ca 4 by 2 mm, membranous, hairy outside, apex acute, margin ciliolate; lower florets male; lower lemma ovate-lanceolate, ca 5 by 2 mm, hyaline, glabrous, apex acuminate, margin ciliolate; lower palea ovate-lanceolate, ca 4.5 by 1.5 mm, hyaline, glabrous, apex acuminate, margin entire; upper florets bisexual; upper lemma narrowly deltoid, ca 3.5 by 1 mm, hyaline, glabrous, apex deeply lobed, margin entire, awn up to 2 cm long; upper palea lanceolate, ca 3 by 1.5 mm, hyaline, glabrous, apex acuminate, margin inrolled. *Stamens* 3, free; filaments ca 1 mm long, glabrous; anthers basifixed, 2-celled, ca 2 mm long, glabrous. *Ovary* and styles not seen; stigma 2, plumose, ca 1 mm long. *Fruit* a grain, elliptic oblong, dark brown, flattened, 3.5–4 by 0.75 mm, glabrous. *Pedicelled spikelets* obliquely deltoid; ca 3 by 2 mm; pedicles ca 1 mm long, hairy outside; lower glume obliquely deltoid; ca 3 by 2 mm, indurated, glabrous, apex obtuse, margin serrulate; upper glume obliquely deltoid, ca 3 by 1.5 mm, membranous, glabrous, apex acute, margin serrulate; lower lemma narrowly deltoid, ca 2.5 by 1 mm, hyaline, glabrous, apex acuminate, margin entire; lower palea narrowly deltoid, ca 2 by 1 mm, hyaline, glabrous, apex acuminate, margin entire; upper lemma deltoid, ca 2.5 by 2 mm, hyaline, glabrous, apex acuminate, margin entire, awn up to 5 mm long; upper palea lanceolate, ca 1.5 by 1 mm, hyaline, glabrous, apex acuminate, margin inrolled. **Plate 14.A.**

**Thailand.**— PENINSULAR: Trang, Satun.

**Distribution.**— China, Myanmar and Malesia.

**Ecology.**— Scattering in wet areas, shallow water and rice fields, more abundant during flood period, disappear during dry period.

**Vernacular.**— Ka dueai nu (กะเดื้อยหนู), Ya kraduk kai (หญ้ากระดุกไก่อ) (Chai Nat); Ya daeng (หญ้าแดง), Ya nok si chomphu (หญ้าหนักสีชมพู) (Bangkok); Ya phraek daeng (หญ้าแพรกแดง) (Ang Thong).

**Specimens examined.**— *P. Pattarakulpisutti et al.* 561, 426 (PSU).

**118. *Panicum* sp.**

Annual herb; culm creeping and erect, up to 30 by 0.1 cm, glabrous. **Leaves** distichous; sheath open, 1–2.5 cm long, with long hairs along margin and throat; absent; blade narrowly lanceolate to linear-lanceolate, 2–5.5 by 0.4–0.8 cm, sub-chartaceous, glabrous, apex acuminate, margin scabrous. **Inflorescences** terminal, spike-like panicle; peduncle 1.5–2 cm long, glabrous; rachis 3–4 cm long, glabrous; spikes 1.8–3 cm long; rachis of spike scabrous. **Spikelets** solitary, elliptic to narrowly elliptic, 3.5–4 by 1.5–2 mm; pedicels 0.5–1.5 mm long, scabrous; lower flower absent; lower glume ovate, ca 3 by 2 mm, membranous, glabrous, apex acuminate, margin entire; upper glume elliptic, ca 4 by 2 mm, membranous, glabrous, apex acuminate, margin entire; lower lemma broadly elliptic, ca 3.5 by 3 mm, membranous, glabrous, apex acuminate, margin entire; lower palea lanceolate, ca 2 by 0.75 mm, hyaline, glabrous, apex acuminate, margin entire; upper florets bisexual; upper lemma elliptic, ca 3 by 2 mm, indurated, glabrous, apex acuminate, margin inrolled; upper palea narrowly elliptic, ca 2.5 by 1.5 mm, hyaline, glabrous, apex acuminate, margin inrolled. **Stamens** 3, free; filaments 0.25–0.5 mm, glabrous; anthers dorsifixed, 2-celled, 1.25–1.5 mm long, glabrous. **Ovary** superior, ca 0.25 mm long, glabrous; styles 2, 1.75–2 mm long; stigma 2, plumose, ca 1 mm long. **Fruit** a grain, brown, elliptic, ca 1 by 0.5 mm, glabrous.

**Thailand.**— PENINSULAR: Trang.

**Distribution.**—

**Ecology.**— Scattering on rather dry areas, roadsides and rice fields, more abundant during dry season, disappear during flood period.

**Vernacular.**—

**Specimen examined.**— *P. Pattarakulpisutti et al.* 280 (PSU).

**Remarks.**— According to all of the available taxonomic literatures, this these specimens are still unidentified. More literatures are needed to clarify its status.

**119. *Paspalum conjugatum*** P. J. Bergius, Acta Helv. Phys.-Math. 7: 129, pl. 8. 1772; Ridl., Fl. Malay. Penin. 5: 218. 1925; Hook. f. in Fl. Brit. India (J. D. Hooker) 7: 11. 1897; Holttum, Rev. Fl. Malaya 3: 180, fig. 37, pl. 24d. 1971.

Annual herb with long stolon; stolon glabrous; internodes, 3–6 by 1–2 mm; culm 18–50 by 0.1–2 cm, glabrous. **Leaves** distichous; sheath open, 2–5 cm long, hairy at throat; ligule membranous, up to 1 mm long; blade linear-lanceolate, 4–13.5 by 0.3–0.8 cm, sub-chartaceous, glabrous, apex acuminate, margin ciliolate. **Inflorescences** terminal, composed of two diverging spikes; peduncle 10–15 cm long, glabrous; spikes 3–10 cm long; rachis of spike flattened, ca 1 mm broad, glabrous. **Spikelets** solitary, appear in two rows on inner side of rachis, sub-sessile, orbicular-obovate, plano-convex, 1.25–1.75 by 1–1.25 mm; lower flower absent; lower glume absent; upper glume orbicular-ovate, 1.25–1.75 by 1–1.25 mm, membranous, glabrous, apex acute, margin ciliate; lower lemma elliptic-obovate to broadly elliptic, 1–1.25 by 0.75–1 mm, membranous, glabrous, apex acute, margin entire; lower palea absent; upper florets bisexual; upper lemma broadly obovate to orbicular obovate, 1.25–1.5 by 0.75–1 mm, indurated, glabrous, apex acute, margin entire; upper palea obovate, 1–1.5 by 1 mm, indurated, glabrous, apex acute, margin entire. **Stamens** 3, free; filaments ca 0.25 mm, glabrous; anthers basifixed, 2-celled, ca 0.5 mm long, glabrous. **Ovary** superior, ca 0.25 mm long, glabrous; styles 2, ca 1 mm long; stigma 2, plumose, 0.75–1 mm long. **Fruit** a grain, golden brown, broadly ovate, flattened, ca 1 by 0.75 mm, glabrous. **Plate 14.D.**

**Thailand.**— PENINSULAR: Trang, Satun, Songkhla.

**Distribution.**— Paleotropics.

**Ecology.**— Scattering in rather dry areas, roadside and rice fields, more abundant in dry season, disappear in flood period.

**Vernacular.**— Ya nom non (หญ้าหนมนอน) (Trat); Ya hep (หญ้าเห็บ) (Peninsular).

**Specimens examined.**— *P. Pattarakulpisutti et al.* 445, 493 (PSU).

**120. *Paspalum longifolium*** Roxb., Fl. Ind. (Roxburgh) 1. 283. 1820; Ridl., Fl. Malay. Penin. 5: 217. 1925; Holttum, Rev. Fl. Malaya 3: 180, fig. 37, pl. 24a, 14. 1971.— *P. platycoleum* Ridl., Fl. Malay. Penin. 5: 217. 1925.

Perennial herb; culm 124–180 by 0.5–0.7 cm, glabrous. **Leaves** distichous; sheath open, 9.5–13 cm long, hairy at throat; ligule membranous, up to 1 mm long; blade linear, 14–26 by 0.4–0.6 cm, sub-chartaceous, glabrous, apex acuminate, margin serrulate. **Inflorescences** terminal, exserted, composed of 4–7 spikes; peduncle 18–24 cm long, glabrous; rachis 7–11 cm long glabrous; spikes 2–4 cm long; rachis of spike flattened, ca 3–4 mm broad, glabrous. **Spikelets** in pairs, appear in four rows on inner side of rachis, sub-sessile, obovate to oblanceolate-ovate, plano-convex, 2–2.25 by 1–1.25 mm; lower flower absent; lower glume absent; upper glume obovate to oblanceolate-ovate, 2–2.25 by 1–1.25 mm, membranous, hairy, apex acuminate, margin entire; lower lemma obovate to oblanceolate-ovate, up to 2 by 1 mm, membranous, hairy, apex acuminate, margin entire; lower palea absent; upper florets bisexual; upper lemma obovate to oblanceolate-ovate in outline, 1.25–1.5 by 0.1–1.25 mm when flattened, indurated, glabrous, apex obtuse, margin inrolled; upper palea elliptic in outline, ca 1.75 by 0.75 mm, indurated, glabrous, apex obtuse, margin inrolled. **Stamens** 3, free, sub-sessile, glabrous; anthers basifixed, 2-celled, ca 0.5 mm long, glabrous. **Ovary** and style not seen; stigma 2, plumose, ca 1 mm long. **Fruit** a grain, dark brown, broadly elliptic, flattened, 1.5–1.7 by 1–1.25 mm, glabrous. **Plate 14.B.**

**Thailand.**— PENINSULAR: Trang, Songkhla.

**Distribution.**— India, Myanmar, Sumatra, Borneo, Philippines and Australia.

**Ecology.**— Scattering in rather dry areas, roadside and rice fields, more abundant during dry season, disappear during flood period.

**Vernacular.**— Ya kap kae (หญ้ากำกับแก) (Ang Thong); Ya plong hin (หญ้าปล้องหิน), Ya wai (Bangkok); Ya phraek hang chang (หญ้าแพรกหางช้าง) (Kanchanaburi); Ya rang takka taen (หญ้ารังตักแต่น) (Nakhon Ratchasima).

**Specimens examined.**— *P. Pattarakulpisutti et al.* 233, 451 (PSU).

**121. *Paspalum scrobiculatum*** L., Mant. Pl. 1: 29. 1767; Holttum, Rev. Fl. Malaya 3: 185, fig. 38. 1971.— *P. commersonii* Lam., Tabl. Encycl. 1: 175, fig. 43. 1791; Ridl., Fl. Malay. Penin. 5: 218. 1925.

Perennial herb; culm tufted, 51–78 by 0.3–0.5 cm, glabrous. **Leaves** distichous; sheath open, 9–12 cm long, sparsely hairy; ligule membranous, ca 1 mm long; blade linear, 4.5–35 by 0.6–0.8 cm, sub-chartaceous, glabrous, apex acuminate, margin serrulate. **Inflorescences** terminal, exserted, composed of 2–4 spikes; peduncle 12–15 cm long, glabrous; rachis up to 8 cm long, glabrous; spikes 4–7.2 cm long; rachis of spike flattened, ca 2 mm broad, glabrous. **Spikelets** solitary, appear in 2 rows on inner side of rachis, sub-sessile, broadly ovate to orbicular, plano-convex, 1.5–2 by 1.25–1.5 mm; lower glume absent; upper glume broadly ovate to orbicular, 1.5–2 by 1.25–1.5 mm, membranous, glabrous, apex obtuse, margin entire; lower flower absent; lower lemma broadly ovate, 1.25–1.5 by 1–1.25 mm, membranous, glabrous, apex obtuse, margin entire; lower palea absent; upper florets bisexual; upper lemma broadly ovate to orbicular, 1.5–2 by 1.25–1.5 mm, indurated, glabrous, apex obtuse, margin entire; upper palea elliptic, ca 1.5–1.75 by 1 mm, indurated, glabrous, apex obtuse, margin entire. **Stamens** 3, free, sub-sessile, glabrous; anthers basifixed, 2-celled, 0.75–1 mm long, glabrous. **Ovary** superior, ca 0.25 mm long, glabrous; styles 2, up to 1 mm long; stigma 2, plumose, ca 1 mm long. **Fruit** not seen.

**Thailand.**— PENINSULAR: Trang, Songkhla.



**Distribution.**— Pantropics.

**Ecology.**— Scattering in rather dry areas, roadside and rice fields, more abundant in dry season, disappear in flood period.

**Vernacular.**— Ya plong hin (หญ้าปล้องหิน) (Bangkok).

**Specimens examined.**— *P. Pattarakulpisutti et al.* 3 91, 420, 477 (PSU).

**122. *Sacciolepis indica*** Chase, Proc. Biol. Soc. Washington 21: 8. 1908; Holttum, Rev. Fl. Malaya 3: 152, fig. 29, pl. 18b. 1971.

Annual herb; culm 26–40 by 0.1 cm, glabrous. **Leaves** distichous; sheath open, 1.5–3.8 cm long, glabrescent; ligule membranous, ca 0.5 mm long; blade lanceolate-linear, 4–11 by 0.2–0.4 cm, sub-chartaceous, glabrous, apex acuminate, margin entire. **Inflorescences** terminal, spike-like panicle, composed of many short spikes; peduncle up to 16 cm long, glabrous; rachis 2.1–1.5 cm long, glabrous; spikes up to 2 mm long; rachis of spike glabrous. **Spikelets** solitary, sessile, obliquely ovate to obliquely lanceolate, 2.25–3 by 1–1.75 mm; lower flower absent; lower glume elliptic, ca 1.5 by 1 mm, membranous, glabrous, apex acuminate, margin entire; upper glume boat-shaped, 2.2–3 by 1.5–2 mm, membranous, glabrous, apex acute, margin entire; lower lemma broadly deltoid when flattened, 2–2.5 by 2 mm, membranous, glabrous, apex acute, margin entire; lower palea narrowly lanceolate, 1–1.25 by 0.25 mm, hyaline, glabrous, apex acute, margin entire; upper florets bisexual; upper lemma broadly lanceolate, ca 1.5 by 0.75 mm, indurated, glabrous, apex acute, margin inrolled; upper palea lanceolate, ca 1.5 by 0.5 mm, indurated, glabrous, apex acute, margin entire. **Stamens** 3, free; filaments ca 0.5 mm, glabrous; anthers basifixed, 2-celled, ca 1 mm long, glabrous. **Ovary** superior, ca 0.5 mm long, glabrous; styles and stigma not seen. **Fruit** a grain, brown, elliptic-oblong, ca 1 by 0.5 mm, glabrous. **Plate 14.E.**

**Thailand.**— PENINSULAR: Trang, Satun, Songkhla.

**Distribution.**— Sri Lanka, India, Myanmar, Peninsular Malaysia, Australia and Polynesia.

**Ecology.**— Scattering on rather dry areas, roadsides and rice fields, more abundant during dry season, disappear during flood period.

**Vernacular.**— Ya plong lek (หญ้าปล้องเล็ก) (Narathiwat).

**Specimen examined.**— *P. Pattarakulpisutti et al.* 469 (PSU).

### PONTEDERIACEAE

**123. *Monochoria hastata*** (L.) Solms, Monogr. Phan. (A. DC. & C. DC.) 4: 523, fig. 200. 1883; Chayam. in Fl. Thailand. 9(1): 54, fig. 2, pl. VI3.2–3.2. 2005.— *M. hastaefolia* Presl, Rel. Haenk 1: 128.1827; Hook. f. in Fl. Brit. India (J.D. Hooker) 6: 362. 1892; Backer & Bakh. f., Fl. Java (Spermatoph.) 3: 97. 1968.

Annual to perennial herb with rhizome and aerial stem; stem erect, several per rhizome, spongy, up to 1 m high, glabrous, sheathing at base; rhizome ca 3.5 cm in diam., covered with the remains of old sheaths. **Leaves** simple; petiole spongy, up to 4 cm long, sheathing at base, glabrous; blade broadly sagittate, 9.5–20 by 6–14 cm, fleshy, glabrous, apex acute, margin entire, base sagittate to hastate. **Inflorescences** below the leaves, sub-umbellate, many-flowered; bracts elliptic to broadly elliptic, 5–5.5 by 1.5–3.5 cm, glabrous, apex acute, margin entire. **Flowers** slightly zygomorphic, 1.5–2 cm in diam.; pedicels up to 1.5 cm long, glabrous. **Perianth** violet-blue, free, tepals 6, unequal, glabrous; three outer ones smaller, elliptic-oblongate, 7–13 by 2–4 mm, glabrous, apex obtuse, margin entire; inner ones obovate-lanceolate, ca 15 by 5 mm, apex obtuse, margin entire. **Stamens** 6, free, unequal; filaments ca 5 mm long, glabrous; anthers basifixed, 2-celled, ca 6 mm long in larger anther and ca 4 mm long in smaller ones, glabrous. **Ovary** superior, ca 2 mm in diam., glabrous, placentation axile, 3-loculed; style 1, 5–6 mm long, glabrous; stigma 1, capitate, ca 0.75 mm in diam., hairy. **Fruit** and **seed** not seen. **Plate 14.F.**

**Thailand.**— Throughout Thailand.

**Distribution.**— Tropical Southeast Asia.

**Ecology.**— In marshy areas, rice fields, shallow water and canal banks. Flowering and fruiting through year.

**Vernacular.**— Phak top (ผักตบ), Phak top thai (ผักตบไทย), Phak pong (ผักโป่ง) (Central).

**Specimen examined.**— *P. Pattarakulpisutti et al.* 465 (PSU).

**124. *Monochoria vaginalis*** (Burm. f.) C. Presl ex Kunth, Enum. Pl. (Kunth) 4: 134. 1843; Hook. f. in Fl. Brit. India (J. D. Hooker) 6: 363. 1892; Ridl., Fl. Malay. Penin. 4: 346. 1924; Backer & Bakh. f., Fl. Java (Spermatoph.) 3: 97. 1968; Chayam. in Fl. Thailand. 9(1): 54, fig. 3, pl. VI2. 2005.

Annual to perennial herb; stem erect, several per rhizome, spongy, 8–10 cm high, glabrous, sheathing at base; rhizome short, covered with the remains of old sheaths. **Leaves** simple; petiole spongy, 2–2.5 cm long, glabrous, sheathing at base; blade sagittate, 2.5–3 by 0.8–1.5 cm, fleshy, glabrous, apex acuminate, margin entire, base cordate. **Inflorescences** below the leaves, raceme, 2–6-flowered; bracts oblong-lanceolate, 1.7–2.2 by 0.4–0.6 cm, glabrous, apex acuminate, margin entire. **Flowers** slightly zygomorphic, 1.5–2 cm in diam.; pedicels 4–8 mm long, glabrous. **Perianth** purplish blue, free, tepals 6, unequal, glabrous; three outer ones narrower, oblong-lanceolate, 13–15 by 3–4 mm, glabrous, apex obtuse, margin entire; inner ones oblong-ovate, ca 15 by 5 mm, apex obtuse, margin entire. **Stamens** 6, free, unequal; filaments 3–5 mm long, glabrous; anthers basifixed, 2-celled, 3–6 mm long in larger anther and 2–3 mm long in smaller ones, glabrous. **Ovary** superior, ca 2–2.5 mm in diam., glabrous, placentation axile, 3-loculed; style 1, 5–6 mm long, glabrous; stigma 1, capitate ca 1mm in diam., glabrous. **Fruit** a capsule, ellipsoid, ca 6 by 3 mm, glabrous. **Seeds** ellipsoid, ca 0.75 by 0.25 mm, glabrous.

**Thailand.**— Throughout Thailand.

**Distribution.**— Tropical Africa, China, Japan and Malesia.

**Ecology.**— In marshy areas, rice fields, shallow water and canal banks. Flowering and fruiting through round.

**Vernacular.**— Kha khiat (ขาเขียด), Ninlabon (นิลบล), Phak khiat (ผักเขียด) (Central); Phal pet (ผักเป็ด) (South-eastern); Phak phet (ผักเพ็ด) (Eastern); Phak rin (ผักรีน) (Peninsular); Phak hin (ผักหิน, ผักฮิ้น), Phak hin nam (ผักฮิ้นน้ำ) (Northern).

**Specimen examined.**— *P. Pattarakulpisutti et al.* 407 (PSU).

### XYRIDACEAE

**125. *Xyris indica*** L., Sp. Pl. 1: 42. 1753; Hook. f. in Fl. Brit. India (J. D. Hooker) 6: 364. 1892; Ridl., Fl. Malay. Penin. 4: 364. 1967; B. Hansen in Fl. Thailand. 5(1): 134. 1987.— *X. robusta* Mart., in Wall., Pl. Asiat. Rar. (Wallich). 3. 30 1832; Hook. f. in Fl. Brit. India (J. D. Hooker) 6: 364. 1892.

Annual herb with erect tufted of leaves, 55–88 cm high. **Leaves** simple, basal; sheath closed, 9–15 cm long, glabrous; ligule absent; blade linear, 26–42 cm by 3–10 mm, fleshy, glabrous, apex acute, margin entire. **Inflorescences** basal, head, 7–13 mm in diam.; scape 28–83 cm long, glabrous. **Flowers** zygomorphic, ca 6 mm in diam.; bracts orbicular to reniform in outline, 4–6 by 4–7 mm, glabrous, apex emarginate, obtuse to truncate, margin entire. **Calyx** brown, free, sepals 3, unequal, glabrous; lateral ones glume-like, obliquely oblanceolate in outline, 5–6 by 2 mm, apex obtuse, margin entire; medial one hood-like, oblanceolate in outline, 6–7 by 3 mm, apex obtuse, margin entire. **Corolla** yellow, gamopetalous, campanulate, 3-lobed, glabrous; tube 5–7 by 5 mm; lobes orbicular, 3–4 by 3–9 mm, apex obtuse, margin erose. **Stamens** 3, free, epipetalous; filaments 2–2.5 mm long, glabrous; anthers basifixed, 2-celled, 1.75–2 mm long, glabrous; staminodes 3, bifid, 1–3 mm long, villose. **Ovary** superior, ca 2 mm in diam., glabrous, placentation parietal, 1-loculed; styles connate at base into tube, ca 3 mm long glabrous; free part ca 2 mm long, glabrous; stigma 3, capitate, ca 1 mm in diam., hairy. **Fruit** and **Seed** not seen.

**Thailand.**— NORTH-EASTERN: Udon Thani, Khon Kaen; EASTERN: Surin; SOUTH-EASTERN: Chanthaburi, Prachin Buri; Central: Nakhon Nayok, Suphan Buri; PENINSULAR: Phangnga, Krabi, Songkhla, Yala, Surat Thani.

**Distribution.**— India, Myanmar, Indochina, Hainan, Malesia and Australia.

**Ecology.**— In old rice fields and open-moist areas, more abundant during flood season, disappear during dry season.

**Vernacular.**— Krathin thung (กระถินทุ่ง), Krathin na (กระถินนา), Ya krathiam (หญ้ากระเทียม), Ya bua (หญ้าบัว) (South-eastern); Ya khi klak (หญ้าขี้กลาก) (Central).

**Specimens examined.**— *P. Pattarakulpisutti et al.* 559, 563 (PSU).

**126.** *Xyris pauciflora* Willd., Phytographia 1: 2, fig. 1, pl. 1. 1794; Hook. f. in Fl. Brit. India (J. D. Hooker) 6: 365. 1892; Ridl., Fl. Malay. Penin. 4: 348. 1967; Hansen in Fl. Thailand. 5(1): 134, pl. VIII3. 1987.

Annual herb with erect tufted of leaves, 28–43 cm high. **Leaves** simple, basal; sheath closed, up to 10 cm long, glabrous; ligule absent; blade linear, 17–35 cm by 1–2 mm, sub-membranous, glabrous, apex acuminate, margin entire. **Inflorescences** basal, head, 3–8 mm in diam.; scape 27–42 cm long, glabrous. **Flowers** zygomorphic, ca 3 mm in diam.; bracts orbicular to obovate, 5 by 3–5 mm, glabrous, apex aristate, margin entire. **Calyx** brown, free, sepals 3, unequal, glabrous; lateral ones glume-like, obliquely oblong to obliquely ovate in outline, 4–5 by 2 mm, apex acute, margin entire; medial one hood-like, obovate in outline, ca 3 by 1 mm, apex obtuse, margin entire. **Corolla** yellow, gamopetalous, campanulate, 3-lobed, glabrous; tube ca 2 by 1 mm; lobes oblong, ca 3 by 2 mm, apex apiculate, margin erose. **Stamens** 3, free, epipetalous; filaments ca 0.5 mm long, glabrous; anthers basifixed, 2-celled, ca 0.5 mm long, glabrous; staminodes 3, bifid, ca 1 mm long, villose. **Ovary** superior, ca 1 mm in diam., glabrous, placentation parietal, 1-loculed; styles connate at base into tube, ca 0.75 mm long glabrous; free part ca 0.75 mm long,

glabrous; stigma 3, capitate, ca 0.25 mm in diam., hairy. **Fruit** a capsule, loculicidal dehiscent, obovate, 4 by 2.5–3 mm, glabrous. **Seeds** oblong, ca 0.5 by 0.25 mm, surface with longitudinal ribbed.

**Thailand.**— Throughout Thailand.

**Distribution.**— India, China, Myanmar, Indochina and Australia.

**Ecology.**— In old rice fields and open-moist areas, more abundant during flood season, disappear during dry season.

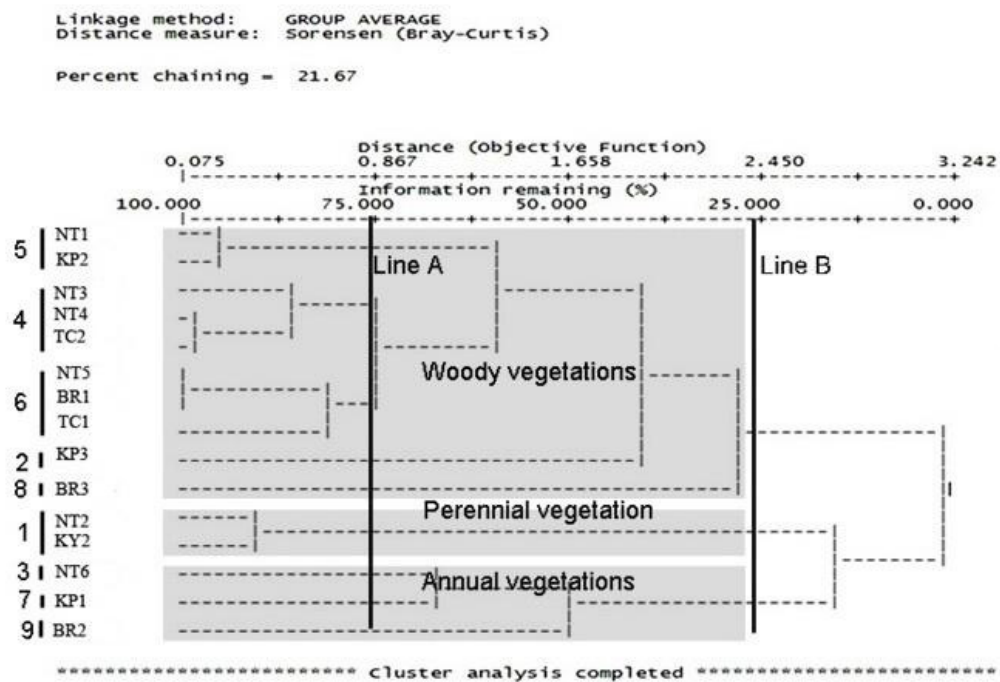
**Vernacular.**— Yak non kai (หญ่ำขงไท่) (Northeastern); Kung (กุง) (Peninsular).

**Specimen examined.**— *P. Pattarakulpisutti et al.* 187 (PSU).

## PART II: VEGETATION STUDY

### The vegetation of the Trang River floodplain

Fifteen study plots (relevé) in the Trang River floodplain vegetation were classified into community types using Cluster analysis. From the hierarchical cluster analysis at 75% similarity level, nine community types were recognized (line A: Figure 5). Naming of the community types were based on abundant species, their physiognomy, and habitats. These community types were recognized as follows:



**Figure 5.** Cluster analysis dendrogram based on similarity of plant species composition and their abundance among study sites.

#### 1. *Actinoscirpus* grassland (NT2 and KY1) (Plate 1.A.)

This type of community could be found in the permanently flooded areas, and the water is up to 1 m depth. A strand flora is formed by the aquatic herbs. The dominant species is *Actinoscirpus grossus* (L.f.) Goetgh. & D.A. Simpson, which formed the more/less pure stand in this vegetation. Minor species which could be found are among many aquatic herbs, e.g. submerged plants: *Ottelia alismoides* (L.) Pers., etc.; emergent aquatic plants: *Lobelia alsinoides* Lam., *Ludwigia octovalvis* (Jacq.) P.H. Raven, *Persicaria attenuata* (R.Br.) Soják, *Acrostichum aureum* L., etc.

## 2. *Barringtonia-Lagerstroemia-Nauclea* woodland (KP3) (Figure 6; Plate 1.D.)

This type of community is composed mainly of tree species and occurring in the areas which flood for three months. The community has 2-storied. The upper layer is 15–20 m high and the crown canopies are rather continuous, and consist mostly of tree species, e.g. *Barringtonia acutangula* (L.) Gaertn., *Lagerstroemia speciosa* (L.) Pers. and *Nauclea orientalis* L. The lower layer is 3–5 m high with many shrubs such as *Streblus asper* Lour., *Kailarsenia campanula* (Ridl.) Tirveng. as well as the saplings of *Barringtonia acutangula* (L.) Gaertn., etc. However in the areas under the canopies of upper layer plants, the ground covers are scarce. On the other hand, in the areas with relatively open upper layered canopy, the pure stand of *Schumannianthus dichotomus* Gagnep. forms the majority together with *Combretum trifoliatum* Vent. and there are also seedlings of *Barringtonia acutangula* (L.) Gaertn. in association.

The epiphytes and climbers are relatively rich in this community, compared with other floodplain community types. The following species were found: *Hoya parasitica* Wall. ex Wight, *Micropera pallida* Lindl., *Dendrobium crumenatum* Sw., *Pyrrhosia piloselloides* (L.) M.G. Prince, *Drynaria quercifolia* (L.) J. Sm., etc.

## 3. *Eleocharis-Fimbristylis* grassland (NT6) (Plate 1.B.)

This is a mixed-herbaceous plants community, and seemingly dominated by the annual species. It was found in the areas which have been relatively long-time inundated (up to 30 cm deep for nine months). During the wet season, the vegetation were dominated by many annual aquatic species i.e., *Fimbristylis miliacea* (L.) Vahl, *Hydrolea zeylanica* (L.) Vahl, *Hymenachne acutigluma* (Steud.) Gilliland. Perennial aquatic plants were also plentiful, e.g. *Eleocharis acutangula* (Roxb.) Schult., *Fimbristylis umbellaris* (Lam.) Vahl and *Scleria poiformis* Retz., etc. On the other hand, during the dry period, the terrestrial annual herbs, e.g. *Eragrostis* sp., *Isachne globosa* Kuntze., *Sacciolepis indica* (L.) Chase would increase their abundances.

## 4. *Lagerstroemia-Streblus-Ziziphus* shrubland (NT3, NT4, TC2) (Plate 1.B.)

In the fringe of the floodplain where inundation seldom occurred as well as on the termite hills which confined to the old semi-permanent flooded rice



fields, the community is mainly composed of shrub and tree species. These species usually occur as the pioneer species in the other dry-land vegetation types, e.g. *Lagerstroemia floribunda* Wall., *Streblus asper* Lour., *Ziziphus oenopolia* (L.) Mill., *Microcos tomentosa* Sm., *Melastoma malabathricum* L., *Antidesma ghaesembilla* Gaertn. The ground cover is rather scarce, however, some species could be detected in low abundance, e.g. *Typhonium flagelliforme* (Lodd.) Blume, *Helminthostachys zeylanica* (L.) Hook, *Melochia corchorifolia* L., etc.

#### 5. *Mitragyna* shrubland (NT1, KP2) (Figure 7; Plate 1.E.–F.)

The *Mitragyna* community was found in the disturbed floodplain areas and old rice fields, where inundation take place for 3–8 months. This vegetation is dominated by shrubs and small trees species. The canopy is continuous, 2–13 (rarely) to 15 m high and has no trace of layering. The dominant species is *Mitragyna diversifolia* Havil. which has formed almost a pure stand of a single plant species. The other components are small shrubs such as *Glochidion rubrum* Blume, *Leea rubra* Blume, and including the seedlings and sapling of *Barringtonia acutangula* (L.) Gaertn. and some scandent species i.e. *Combretum trifoliatum* Vent. Epiphytes and climbers are rare. The ground cover species had shown a seasonally dynamic. It is composed mainly of perennial and annual herbs in Cyperaceae and Poaceae. Many of them are also found in *Eleocharis-Fimbristylis* grassland.

#### 6. *Mitragyna-Lagerstroemia-Glochidion* shrubland (NT5, BR1, TC1) (Figure 8; Plate 1.G.–H.)

This community might be the intermediate community between the *Lagerstroemia-Streblus-Ziziphus* shrubland and the *Mitragyna* shrubland. It was found on the old rice fields where would be flooded for 3–8 months. The species composition is similar to those former two mentioned communities, but differs in relative abundance (see Appendix 1). The dominant species are among *Mitragyna diversifolia* Havil., *Antidesma ghaesembilla* Gaertn., *Glochidion rubrum* Blume, *Leea rubra* Blume and *Ziziphus oenopolia* (L.) Mill. The ground cover composition could vary from a plot with no ground cover to a plot where annual aquatic plants, such as *Cyperus haspan* L., *Fimbristylis miliacea* (L.) Vahl, *Cyperus pulcherrimus* Willd. ex Kunth are dominant during inundation period. During dry period, those species would

be replaced by the terrestrial herb species, e.g. *Paspalum longifolium* Roxb. and *Cynodon dactylon* (L.) Pers., etc.

#### 7. *Paspalum-Cynodon-Hymenachene* grassland (KP1) (Plate 1.C.)

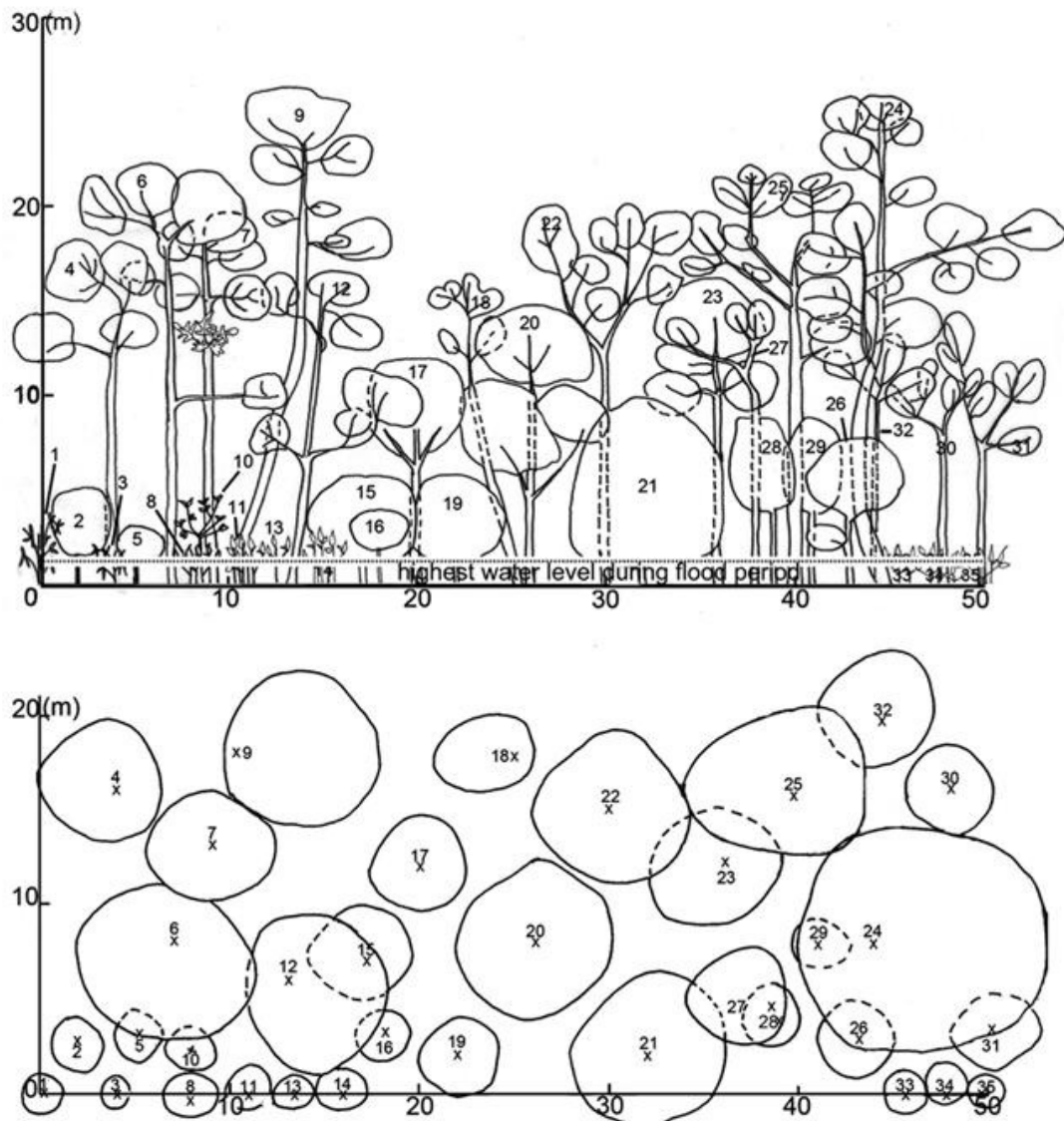
In the seasonally flooded area, where the ground have been inundated for 3 months, the community is mainly composed of annual herbs. Moreover, there is a seasonally dynamic in the vegetation: In the dry period, the vegetation is dominated by annual terrestrial herbs, e.g. *Cynodon dactylon*, *Panicum* sp., *Paspalum conjugatum* P.J. Bergius, *Paspalum longifolium* Roxb., *Kyllinga brevifolia* Rottb., *Borreria alata* (Aubl.) DC. During flooded period, these terrestrial annual herbs would be replaced by annual aquatic plants, e.g. *Persicaria attenuata* (R.Br.) Soják, *Cyperus haspan* L., *Cyperus pilosus* Vahl and *Hymenachne acutigluma* (Steud.) Gilliland, etc.

#### 8. *Streblus-Ziziphus-Adenantha* shrubland (BR3)

This community type is found on the termite hills in the floodplain areas and mainly composed of shrub species which usually found on the other dry areas as well. Only seven plant species were found i.e. *Uvaria rufa* Blume, *Gloriosa superba* L., *Stemona* sp., *Microcos tomentosa* Sm., *Ziziphus oenopolia* (L.) Mill., *Streblus asper* Lour. and *Adenantha pavonina* L. It is to be noticed here that this mentioned type of community might be a part of *Lagerstroemia-Streblus-Ziziphus shrubland* which left fragmented on the termite hills in the floodplain areas as 5 of 7 species are belonging to the *Lagerstroemia-Streblus-Ziziphus shrubland*.

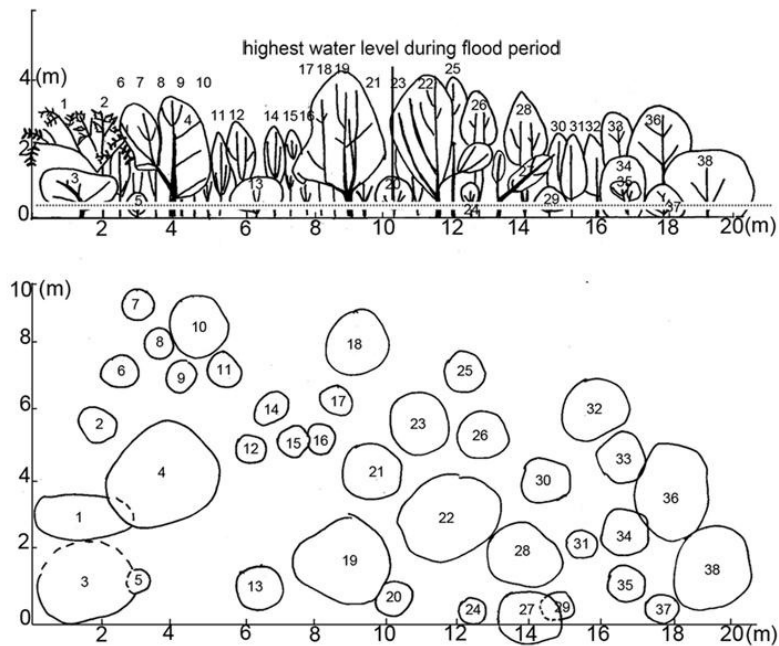
#### 9. *Utricularia-Eriocaulon* grassland (BR2)

In the areas where are nearly permanent inundated, (up to 30 cm deep), the vegetation is dominated by the annual aquatic plants. Some of which are usually found in the bog and nitrogen deficient areas i.e. *Drosera indica* L., *Utricularia bifida* L., *Utricularia caerulea* L., *Fimbristylis miliacea* (L.) Vahl, *Fimbristylis schoenoides* Vahl, *Salomonina longiciliata* Kurz, *Stylidium tenellum* Sw. ex Willd., *Eriocaulon truncatum* Buch.-Ham. ex Mart. and *Eriocaulon xeranthemum* Mart. (pers.obs). However, in the relatively dryer areas, *Fimbristylis acuminata* Vahl is plentiful. In the dry period, most plants in such community would dry out.



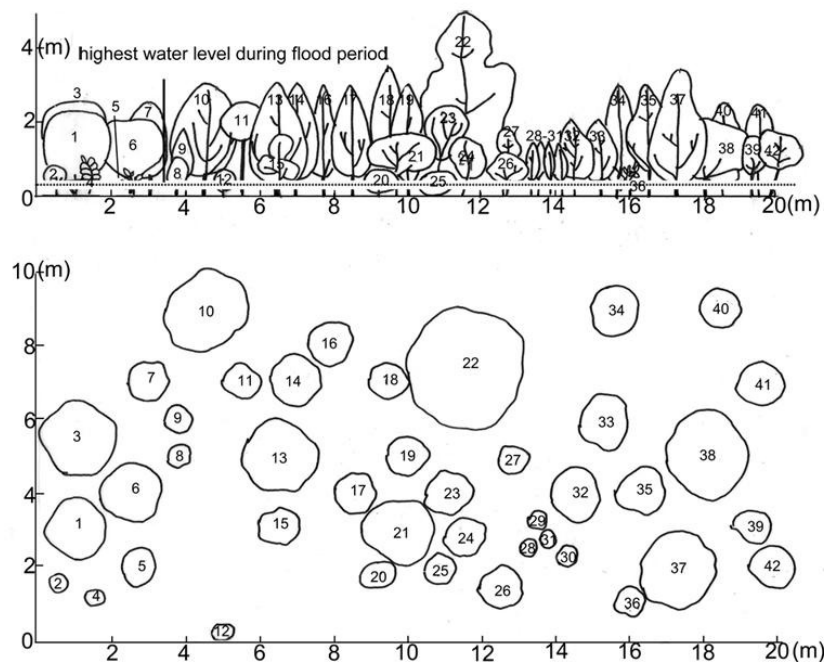
**Figure 6.** Profile diagram of the *Barringtonia-Lagerstroemia-Nauclea* woodland.

1,3= *Combretum trifoliatum* Vent.; 2,5,16,17,19–22,26,28–29= *Barringtonia acutangula* (L.) Gaertn.; 4,24–25,30–32= *Nauclea orientalis* L.; 6–7,9,12,18,23,27= *Lagerstroemia speciosa* (L.) Pers.; 8,11,13–14,33–35= *Schumannianthus dichotomus* Gagnep.; 10= *Mitragyna diversifolia* Havil.; 15= *Xanthophyllum eurhynchum* Miq.



**Figure 7.** Profile diagram of the *Mitragyna* shrubland

1= *Aganosma marginata* (Roxb.) G. Don; 2= *Croton caudatus* Geiseler; 3–4,6–23,25–32,34,36–37= *Mitragyna diversifolia* Havil.; 5,38= *Combretum trifoliatum* Vent.; 24,35= *Barringtonia acutangula* (L.) Gaertn.; 33= *Glochidion rubrum* Blume



**Figure 8.** Profile diagram of the *Mitragyna-Lagerstroemia-Glochidion* shrubland.

1,11= *Barringtonia acutangula* (L.) Gaertn.; 2,3,6–7,9,10,12–14,16–20,28–35,37,39,41= *Mitragyna diversifolia* Havil.; 4= *Tamilnadia uliginosa* (Retz.) Tirveng. & Sastre; 5,36= *Leea rubra* Blume; 8,22= *Lagerstroemia floribunda* Wall.; 15,23,27,40,42= *Glochidion rubrum* Blume; 21,26,38= *Antidesma ghaesembilla* Gaertn.; 24,25= *Ziziphus oenopolia* (L.) Mill.

### Relative abundance of growth strategies/life forms of each community type

One hundred and sixty species of vascular plants were recorded in fifteen study plots (relevé) during the surveys (others 11 species present in the species list were excluded in this analysis because they were found outside the plots hence, make complication in the analysis). According to nine community types based on the vegetation classification above, the relative abundance of growth strategies/life-forms of all species found in each community types were performed in percentage in Table 5.

**Table 5.** Percentage cover of growth strategies/life forms in each community type along Trang River floodplain.

Growth strategies/life forms <sup>1</sup>	Community types <sup>2</sup>									
	1	2	3	4	5	6	7	8	9	
Annual herbs	Aasa			4			1			
	Aaff						1			
	Aaem	44	42	72	29	3	1	20	12	
	Ath	20	47	18		2	1	10	6	
	Atv	2			2	1	3	3	2	
Perennial herbs	Paem	29	6	7	40	5		10	3	
	Pag					2	1		1	
	Pte					9	1	1		
	Pth	5	5	3	9	1		3	2	
	Ptv				2	9	6	2	5	14
Woody species	Pa/t					5	1			
	Pas				7			1		
	Pa/ts					3	4		2	
	Pa/tt					3				
	Ptc					6	5	6	2	
	Pts					23	39	17	30	76
	Ptt					23	25	18	21	
	Ptu						4	5	7	
Ptw				7	5	9	2	8	10	

<sup>1</sup>Abbreviation of growth strategies/life forms are as in Figure 4.

<sup>2</sup>1= *Eleocharis-Fimbristylis* grassland, 2= *Paspalum-Cynodon-Hymenachene* grassland, 3= *Utricularia-Eriocaulon* grassland, 4= *Actinoscirpus* grassland, 5= *Barringtonia-Lagerstroemia-Nauclea* woodland, 6= *Lagerstroemia-Streblus-Ziziphus* shrubland, 7= *Mitragyna* shrubland, 8= *Mitragyna-Lagerstroemia-Glochidion* shrubland, 9=*Streblus-Ziziphus-Adenantha* Shrubland.

According to the relative growth strategies/life forms, the floodplain community types can be categorized into 3 main groups (Table 5):

1. The vegetation dominated by annual herbs i.e. *Paspalum-Cynodon-Hymenachene* grassland, *Utricularia-Eriocaulon* grassland, and *Eleocharis-Fimbristylis* grassland. This group was found on the disturbed and inundated last from 3–4 and 8 months respectively.

2. The vegetation dominated by perennial herbs i.e. *Actinoscirpus* grassland, was found on the disturbed and inundated all year round.

3. The vegetation dominated by perennial woody species i.e. *Mitragyna* shrubland, *Mitragyna-Lagerstroemia-Glochidion* shrubland, *Lagerstroemia-Streblus-Ziziphus* shrubland, *Barringtonia-Lagerstroemia-Nauclea* woodland and *Streblus-Ziziphus-Adenantha* shrubland. This group was found on the semi-permanently flood areas, the seasonally flooded areas and the infrequently flooded areas.

## CHAPTER 4

### DISCUSSION AND CONCLUSION

#### **Taxonomic diversity and species richness**

In the present study, 171 species of vascular plants were recorded. The species richness of plants in Trang River floodplain vegetation is relatively low, compared to the terrestrial plant vegetation in peninsular Thailand, especially semi-evergreen rain forests. For examples, Siriruga *et al.* (1999) recorded 905 species of vascular plants at Ton Nga chang wildlife sanctuary; Leeratiwong and Joraead (2003) recorded 543 species of vascular plants at Sriphangnga National park. In any case, in the tropics, low diversity forests are common in seasonally waterlogged conditions (Duivenvoorden, 1996; Nebel *et al.*, 2001a; 2001b; Poralin *et al.* 2003; Poralin *et al.* 2004). The relative low species richness compared to terrestrial vegetation also common in others types of swampy areas such as peat swamps and mangrove forests. According to Duivenvoorden (1996) the reduction of a species richness of the inundation areas compared to adjacent upland areas might be a result of inability of the terrestrial species to colonize the floodplain due to the flooding stress. However, the ability of flood tolerance of species from the Trang River floodplain and the adjacent non-flooded areas, especially tree species should be experimentally compared later in order to test the role of tolerance in the contributing to the poor species diversity in these inundated areas.

Considering the plant species composition of the Trang River floodplain vegetation, the most common families of each major group were Fabaceae, Phyllanthaceae and Rubiaceae for Eudicots, Cyperaceae and Poaceae for Monocots, Pteridaceae for Monilophytes and only two species of Magnoliids were found. It is not surprising as they are also the largest families of plants in the Thai flora. In Thailand, there are about 248 and 600 species of Cyperaceae and Poaceae, respectively (Larsen and Nielsen, 1994; Simpson and Koyama, 1998). Due to the fact that most of Trang-River floodplain areas are open areas and subjected to periodic flood, the elements of both Cyperaceae and Poaceae are usually common in such vegetation of wetland areas as many of them are both aquatic and terrestrial herbs.

Concerning the rest of plants beside the Monocots, the Fabaceae is the largest one, followed by Phyllanthaceae and Rubiaceae, respectively. In the present study, Phyllanthaceae is among the shrubs which could be found in the shrubland vegetations (see Appendix 1). Moreover, they are among the majority of pioneer plants which would occur when the vegetation had been disturbed. For Rubiaceae and Fabaceae, generally these families are diverse in habits and life forms. In this study, both families could be found in many types of vegetation as trees, shrubs, herbs and vines. Thus, these two families are the most diverse in the floodplain vegetation.

However, it is interesting to note that Orchidaceae, one of the largest families of vascular plants (Dressler, 1993) and there are about 1,200 species in Thailand (Thaithong, 1999), only four species were found in this study. This is probably due to the biology of the orchids that usually adapts to survive in xeric habitats. Most of the orchid species are epiphytes or lithophytes on the exposed rocks or in the highland and coastal heaths. Because of most areas of the Trang River floodplain are open areas and subjected to periodic flood, orchids may not tolerate in such conditions, thus the diversity of orchid is rather in low the floodplain vegetation.

### **Growth strategies/life forms and morphological adaptations of plants in Trang River floodplain vegetation**

Generally, in the aquatic and wetland plant communities, most dominant species usually belong to perennial-aquatic herbs and are categorized as the free floating and submerged plants as described by Finlayson *et al.* (1989). However, in this study, 62% the total plants species belong to the terrestrial plants and only 48% species are aquatic plants (Figure 4.). In addition, most of the aquatic plants are annual-emergent species. This is might due to the alternation between the flood and dry period of the floodplain. During the dry period of seasonally flooded areas, the terrestrial plants are able to persist in this period, but the aquatic plants cannot live without water for any significant period of time, thus they disappear during this time. Whereas during the flood period, only some annual-terrestrial plants disappear, but the perennial counterparts can still resist through this period. As follow, diversity of the terrestrial plants is greater than the aquatic ones in this kind of habitat. In addition, because of flood pulse, the perennial aquatic plants cannot complete their life cycle



before the dry period except some areas where the water body is permanent. The annual strategy has more advantage to this habitat for aquatic species, because they survive the unfavorable period as seeds that would germinate in the next flood season. This strategy enable them to cope both flood and dry period, thus most of the aquatic species are annual. Moreover, due to the shallow water during the flood (30 cm–1 m in depth) in this habitat, the emergent aquatic species are more predominated than the submerged and the free floating ones.

Unlike the annual species that can avoid flood period, escaping from flooding is impossible in woody species, so they have to persist through this stress. Visible morphological adaptations regarded to inundation were observed only in few species. Lenticels were observed only in *Derris elliptica* Benth., *Derris scandens* (Roxb.) Benth. and *Streblus perakensis* Corner. Special kinds of root adaptations, e.g. for oxygen shortage and/or for better mechanical support such as prop roots, buttresses, pneumatophores and knee roots were not found. This result concurs with observation in central Amazonia floodplain (Parolin, 2001; Parolin *et al.*, 2004). The floodplain plants may diminish the effect of oxygen depletion through physiological adaptation. Thus the adventitious roots might be the direct respond to soft substrate rather than the respond to oxygen depleted condition. Due to the fact that the floodplain soils are not soft as peat swamp and mangrove soils, so the adventitious roots formation may not necessary for woody plants in Trang River floodplain. Nevertheless, further experiments are needed to test the role of the adventitious roots. Moreover, some other morphological adaptations to flooded soil such as deep primary root, shallow root system and physiological adaptation are still needed to be investigated in order to explain why these species are able to tolerate flood period.

Lopez (2001) suggested that the ecological factors such as seed dispersal and flood tolerance of seedling are critical in determining species establishment and survival in flooded vegetation. In addition they might be equal or more important factor that might constrain floodplain species than flood tolerance in the adult ones. Some traits that might be an adaptation for germination and establishment in inundation were recognized in Trang River floodplain species. Diaspores of many species in the floodplain show some potential to be hydrochory, e.g. the cork-like pericarp in *Barringtonia acutangula* (L.) Gaertn., *Barringtonia*

*racemosa* (L.) Spreng., or winged fruits in *Combretum trifoliatum* Vent., *Hymenocardia punctata* Wall. and spongy syncarps in *Nauclea orientalis* L. These traits enable them not only for flotation and hydrochory but also maintain seed viability by preventing tissue damage from oxygen depleted condition. Seed buoyancy is also important adaptation in other inundated habitats areas such as Mangrove (Rabinowitz, 1978), Central America floodplain (Lopez, 2001) and northern Australia floodplain plant species (Finlayson, 2005).

It is to be considered here also that *Mitragyna diversifolia* Havil., the dominant species in disturbed and seasonally flooded areas, was occurring in rather low abundance in the infrequently flooded areas and has never been found in the permanently flooded areas. This might due to its life history which related to the alteration of flood and dry period as described by Finlayson (1989) and Middleton (2000). The seeds (or whole fruits) of *Mitragyna diversifolia* Havil. may be dispersed by water and the germination may occur on the moist soil during the early dry or the late flood period, thus this species may require both dry and flood period for establishment and maintaining their population. These life history characteristics may be similar in some shrub and tree species of *Barringtonia-Largerstroemia-Nauclea* woodland vegetation. However, the future study on timing of seed raining, an aquatic dispersal, post flooded establishment of seeds and flood tolerance of seedling in floodplain plants are needed in order to explain this phenomenon.

### **Phytogeographical affinities**

Based on geographical distribution, the species recorded in the floodplain could be divided into 13 types (Table 4.). It is to be noticed here that one-fourth of total flora is widely distributed group (type 1–6). Most of them are herbaceous species in open areas and they are commonly known throughout the tropics and paleotropics and have no special phytogeographical importance. Concerning on the rests, the phytogeographical affinities of the flora in this floodplain are predominated by Indomalesian subkingdom elements (39.07%), followed by the Indian and Indochinese elements (14.57%), and the Indochinese and Malesian elements (12.58%), respectively. This result confirms that the flora in this area belong

to the part of Indomalaysian subkingdom elements that range from South Asia on the west through Samoa Islands on the east (Takhtajan, 1988).

According to Whitmore (1975), peninsular Thailand lies in transition zone between two floristic regions, Indochinese region and Malesian region. However the exact border line between these regions is still poorly documented. There are two possible northern limit of Malesian flora, first the Isthmus of Kra and second, the best known Kangar-Pattani line, also reviewed at length in Woodruff (2003). In this study, Trang River floodplain vegetation support only 9 species (5.96%) restricted to Malesian region and 4 species (2.64%) restricted to Indochinese region. This result is too far to support the position idea of the northern limit of Malesian flora. Thus, it could only be interpreted here that most of the Trang River floodplain flora widely distributed and might be distributed through the similar habitats throughout Indomalaysian subkingdom. It is suggested here that furthers intensive plants collection and surveys in other type of habitat are need in order to clarify the phytogeographical affinities of floras in this areas.

### **Spatial variations in composition and structure among the vegetation types of Trang-River flood plain vegetation**

The community types according to vegetation classification could be categorized into three main groups based on the dominant growth strategies/life forms i.e. (1) the vegetation dominated by annual herbs, (2) the vegetation dominated by perennial herbs, and (3) the vegetation dominated by perennial woody species (Table 5). It is to be noticed here that the result from cluster analysis had supported this growth strategies/life forms-based classification. At 25% similarity level, the community types could be roughly categorized into 3 main groups as classified by growth strategies/life forms (line B: Figure 5).

Those three groups are not only different in habitat distributions, but show variations in vegetation structure as well. The spatial variations within the floodplain vegetation is discussing in accordance with these three main groups. The results form vegetation analysis indicated that the differences in the successional stages which due to the history of land uses may have impacts on the species

composition and structure of the vegetation at a broad scale, while at a finer scale, the water regime seem to have more impacts.

1. The vegetation dominated by annual herbs

The vegetation dominated by annual herbs was found on the disturbed areas, e.g. old rice fields and the clear-cut areas, etc. According to Odum (1969) the small size of plants, the rapid rate of growth as well as the short life cycle are the characteristic of organisms in the early stage of succession, this may indicated that they were developing in the early stage of succession. Moreover, it is to be noticed also here that these vegetation was found on the areas where the distinct seasonal dynamic occurred. Due to the alternation period of drying and inundation, the annual strategy has more advantage as it could complete their life cycle before unfavorable period (depend on whether they are aquatic or terrestrial species) and leave their seeds to establish in the next suitable season. This strategy also helps them to quickly colonize the unoccupied land after a disturbance. Therefore this strategy is predominant in frequent disturbed and unpredictable environment in such areas (see also Finlayson *et al.* 1989; Capon 2005).

2. The vegetations dominated by perennial herbs

The vegetation dominated by perennial herbs was found on disturbed areas and might be developing in the early stage of succession as well as the former one. However, the difference in physical setting between these two vegetation types is the water regime. In the *Actinoscirpus* grassland the soils would never dry out even during the dry season, this condition is suitable for aquatic plant species. Due to the relatively stable environmental condition, compared to the vegetations dominated by annual herbs, the perennial aquatic plant species in this vegetation would have enough time to complete their life cycle. Therefore, in this condition the perennial species has more advantage than the annual strategies, thus they are predominant. This result reveals the role of flood duration in differentiating the species composition and structure of these two vegetation types.

3. The vegetation dominated by perennial woody species

Based on the relative complex in the vegetation structures of the *Barringtonia-Largerstroemia-Nauclea* woodland, compared with other types of vegetation in the Trang River floodplain, this woodland is considered as the more or

less “primary vegetation” which has been occurred in the study areas originally. Comparing with other types of vegetation in the Trang River basin, it has relatively complex structure, e.g. 2-layers, dominated by large trees and richer in epiphytes, etc. In any case, more information on the vegetation history is, therefore, needed in order to confirm this observation.

On the other hand, in the case of disturbed areas, the *Mitragyna* shrubland and the *Mitragyna-Lagerstroemia-Glochidion* shrubland were found in replace of the former mentioned woodlands. It is to be noticed that these shrubland-communities share similar environmental conditions with the vegetations dominated by the annual herbs. According to the appropriate duration of the secondary succession, the small tree and shrub species could establish and dominate in the woody vegetation (and not the annual species). Moreover, the similarity between the ground cover species of *Mitragyna* shrubland and the main components of *Eleocharis-Fimbristylis* grassland suggested that the *Eleocharis-Fimbristylis* grassland might has a potential to develop as the *Mitragyna* shrubland later. It is suggested here also that the differences in successional stages due to the history of land use among the study areas, would be responsible for the variations in species composition, structure and distribution between the vegetation types at a broad scale, while at a finer scale the water regime seem to have more impacts. In addition, the occurrence of the seeding of *Barringtonia acutangula* (L.) Gaertn., the dominate species in *Barringtonia-Lagerstroemia-Nauclea* woodland in the *Mitragyna* shrubland suggested that this vegetation types might be replaced by the *Barringtonia-Lagerstroemia-Nauclea* woodland later. The *Mitragyna* shrubland and the *Mitragyna-Lagerstroemia-Glochidion* shrubland species may act as a shelter and provided suitable condition for the establishment of the *Barringtonia-Lagerstroemia-Nauclea* woodland species such as *Barringtonia acutangula* (L.) Gaertn., etc.

Considering the *Lagerstroemia-Streblus-Ziziphus* shrubland and the *Streblus-Ziziphus-Adenanthera* shrubland, these communities have occurred on the infrequent flooded areas. The infrequent flooded phenomena of the mentioned areas is owing to the temporary island-like topography in the flood period, as they occurred in the form of small mounds of 1–2 m high, or sometimes these communities may occur on the “termite hills” which could be found scattering in any flooded areas in the

Trang River basin. According to this non-flooded condition, the *Lagerstroemia-Streblus-Ziziphus* shrubland and the *Streblus-Ziziphus-Adenantha* shrubland are dominated by the species which usually be found on other dry habitats, e.g. *Microcos tomentosa* Sm., *Streblus asper* Lour., *Ziziphus oenoplia* (L.) Mill., etc.

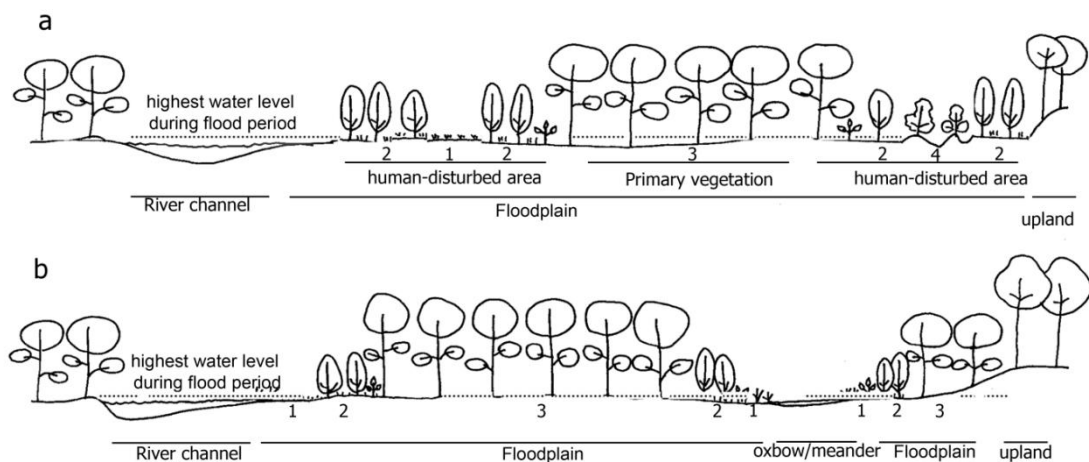
### **Expected original vegetation in the Trang River basin**

The spatial variation and differences in habitat distribution among the vegetation types in the present study might be explained primarily by the differences in stages of secondary succession. The variation along lateral gradient happens to be the reflection of a human disturbance rather than natural processes (Figure 9a.). All of the vegetation types except the *Barringtonia-Lagerstroemia-Nauclea* woodland might be during the transitional stages of succession. In any case, floodplains are characterized by the dynamic of fluvial landforms and natural succession, which is usually associated with a particular kind of vegetation (Tepley *et al.*, 2004; Wittmann *et al.*, 2004). The stages of succession can be seen as a zonation from the frequently disturbed areas i.e. near the river bank to the stable areas such as the distance part from the bank. Secondary succession of the existing vegetation due to human activities in the floodplain vegetation of Trang River may reflect natural-successional course due to this dynamic of fluvial landforms along the lateral gradient. And based on these data of the natural-successional courses, the expected vegetation of the Trang River basin is, therefore, proposed.

The succession process might be initiated on the newly sedimentation site, e.g. the inner side of a curve of the river, abandoned meanders or the oxbow lakes. The early stage of succession might be predominated by the herbaceous vegetation. Either perennial or annual herbaceous vegetation would occur, depending on the water depth and the seasonal dynamic of the water regime. This herbaceous vegetation would be able to trap and consolidate the additional sediment and, therefore, providing suitable habitats for the later colonizers. Then, these types of vegetation might be replaced by the *Mitragyna-Lagerstroemia-Glochidion* shrubland or the *Mitragyna* shrubland. Finally, succession process might end up with the *Barringtonia-Lagerstroemia-Nauclea* woodland. Therefore, the lateral gradient from the river channel to upland in the natural floodplain might represent different stages of

the succession (Figure 9b.). However, this final or the so-call “climax” vegetation might be disturbed again by the natural erosion process of the flood and then the (secondary) succession would rerun again.

Nevertheless, as all the remnants in the Trang River floodplain have been left only near the river channel and the *Barringtonia-Lagerstroemia-Nauclea* woodland is only one type of the so-to-speak “primary” vegetation left on this floodplain, more natural vegetation types could be, therefore, expected in the past. In particular, the vegetation types which located apart from the river channel. Therefore, in order to gain the complete picture of floodplain vegetation, more intensive surveys in future as well as the pollen analysis of the former plant species composition of the vegetation in the study areas are, therefore, needed.



**Figure 9.** Schematic transect of vegetation distribution along lateral gradient from river channel to upland areas in Trang-River basin floodplain vegetation, comparing between a) spatial variation from the result of secondary succession due to human disturbance in actual vegetation and b) the expected vegetation of floodplain showing the lateral gradient due to the natural succession.

1= the vegetation dominated by annual species and/or the vegetation dominated by perennial herbs, 2= the *Mitragyna-Lagerstroemia-Glochidion* and/or the *Mitragyna* shrubland, 3= the *Barringtonia-Lagerstroemia-Nauclea* woodland, 4= the *Lagerstroemia-Streblus-Ziziphus* shrubland.

### Conclusion and suggestions for further studies

This study is an overview of the floristic study of Trang River floodplain vegetation. The observation has shown roughly pattern of species richness, diversity, composition and vegetation structure, some morphological adaptations and spatial variation within the floodplain vegetation. These are basic information that

could help to understand ecological processes underlying this ecosystem. However, the study plots in this study were done only in the areas near the river channel. Species richness and species composition in this study thus, might be underestimated, especially the lack of plant species adjacent to upland areas. Therefore more inventories on the continuous and non-disturbed patches of floodplain vegetation throughout Thailand should be undertaken in order to gain more comprehensive patterns of species richness, distribution, ecology and biology of plant species. The study on large patches of floodplain would also provide the opportunity to gain clearer pattern of plant zonation along lateral gradient. There might be a good model to study the relationship between plant zonation and environmental gradients, such as fluvial landforms and their dependent factors, e.g. water depth, flood frequency, flood duration in floodplain vegetation, etc.

By the way, the flood tolerance and physiological respond to the flooding in the floodplain species might be another interesting issue, especially when compared with the adjacent upland species. These could contribute to understand the factors that may constraint the floodplain species. Moreover, reproductive phenology and seeds dispersal mechanism could be also an interesting phenomenon. This study has demonstrated that diaspores of some woody species might adapt for dispersed by water. In additions, some woody species might require both flood and dry period for diaspores dispersal and seedling establishment. However, the relationship between maximum fruiting period, timing of diaspores release and inundation period, flood tolerance of diaspores, dormancy and/or requirements for germination and seedling establishment should be carried out in order to understand many phenomena observed in this study.

### **Conservation recommendations**

The floodplain vegetation is not only important in terms of plant diversity and plant genetic resources of its own type, but it performs a nursery place for the larvae as well as feeding/breeding areas of the aquatic fauna in the flood season. So far, the floodplains and alluvial plains of different parts in Thailand have been terminated by various agricultural activities, especially rice cultivation as well as many irrigation and numbers of land developmental projects throughout the country



including dam and reservoir operations. There are only some remnants left as separated patches, distributed in various river basins, however, very few. It is unfortunately that almost all of those patches have not been included in any reservation areas, either by law or a local community protection. Many of native plant species had already disappeared from their original habitats. Some might be even extinct already from nature. Furthermore, in most river basins, the natural periodic flood had not taken place anymore and some areas were turned to be permanently flooded due to the effective irrigation managements. Without the flood, the natural floodplain plants may be replaced by species of dry habitat. On the other hand, in permanently flooded condition, the natural floodplain vegetation may change into aquatic plant communities as in open water (see also Middleton, 2002). If the natural water regime in maintaining the natural floodplain vegetation would not be taken into account for the irrigation projects managements as well as various agriculture activities together with the ignorance of the authorities concerned and the local inhabitants, this rare habitat would then be disappeared soon from the former river basins, at least in the peninsular Thailand.

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## **APPENDICES**

**APPENDIX 1.** List of vascular plants occurring at Trang River floodplain vegetation, Trang province.

Family	Scientific name	Life form/ Growth strategy	Study plot reference number <sup>1</sup>															Voucher <sup>2</sup>
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	
<b>MONILOPHYTES</b>																		
Lygodiaceae	<i>Lygodium microphyllum</i> (Cav.) R.Br.	Ptv	1			1		1	1	1		1	1	1	*		Patt. 220	
Ophioglossaceae	<i>Helminthostachys zeylanica</i> (L.) Hook.	Pth													*		Patt. 471	
Polypodiaceae	<i>Drynaria quercifolia</i> (L.) J.Sm.	Pte							2								Patt. 283	
	<i>Pyrrosia piloselloides</i> (L.) M.G. Prince	Pte							2								Patt. 219	
Pteridaceae	<i>Adiantum</i> sp.	Pth							1						1			
	<i>Ceratopteris thalictroides</i> (L.) Brongn.	Aaem		3														
	<i>Acrostichum aureum</i> L.	Paem						4										

<sup>1</sup>1=NT2R3(*Eleocharis-Fimbristylis* grassland); 2=KP1(*Paspalum-Cynodon,-Hymenachene* grassland); 3=BR1R2(*Utricularia-Eriocaulon* grassland); 4=NT1R2, 5=KY1(*Actinoscirpus* grassland); 6=KP3(*Barringtonia-Lagerstroemia-Nauclea* woodland); 7=NT1R3, 8=NT2R1, 9=BR2R2(*Lagerstroemia-Streblus-Ziziphus* shrubland); 10=NT1R1, 11=KP2(*Mitragyna* shrubland); 12=NT2R2, 13=BR1R1, 14 BR2R1(*Mitragyna-Lagerstroemia-Glochidion* shrubland); 15 BR1R3 (*Streblus-Ziziphus-Adenanthera* shrubland)

<sup>2</sup>No voucher is available for many plant species due to incomplete collection or damage during transportation or processing.

=Species that were excluded from cluster analysis because they were found outside the study plots.

=Species that were excluded from geographical distribution analysis as they are unidentified and some might be non-indigenous species.

**APPENDIX 1.** (Continued).

Family	Scientific name	Life form/ Growth strategy	Study plot reference number <sup>1</sup>															Voucher <sup>2</sup>
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	
<b>EUDICOTS</b>																		
Acanthaceae	<i>Staurogyne</i> sp.	Ath												2			Patt. 562	
Amaranthaceae	<i>Alternanthera sessilis</i> (L.) R.Br. ex DC.	Aaem										2					Patt. 408	
Apocynaceae	<i>Aganosma marginata</i> (Roxb.) G. Don	Ptc								3							Patt. 240	
	<i>Atherandra acutifolia</i> Decne.	Ptv													1		Patt. 565	
	<i>Hoya parasitica</i> Wall. ex Wight	Ptv					1										Patt. 217	
	<i>Taxocarpus</i> sp.	Ptv								2							Patt. 458	
	<i>Ichnocarpus frutescens</i> R.Br	Ptv								1							Patt. 165	
	<i>Tylophora indica</i> Merr	Ptv						1									Patt. 224	
	<i>Tylophora tenuis</i> Blume	Ptv						2	2								Patt. 234	
	<i>Wrightia religiosa</i> Benth. & Hook.f.	Pts									2							Patt. 181
Asteraceae	<i>Eclipta prostrata</i> L.	Pth										2	*				Patt. 350	
Balsaminaceae	<i>Hydrocera angustifolia</i> Blume	Aaem	2									3					Patt. 342	
Bignoniaceae	<i>Dolichandrone columnaris</i> Santisuk	Ptt													3		Patt. 268	
Boraginaceae	<i>Heliotropium indicum</i> L.	Ath										2	3				Patt. 235	
Campanulaceae	<i>Lobelia alsinoides</i> Lam.	Aaem	3													2	Patt. 453	
Cleomaceae	<i>Cleome ruidosperma</i> DC.	Ath						2					1				Patt. 284	
	<i>Combretum trifoliatum</i> Vent.	Ptc						3	1			5	3		4		Patt. 178	



**APPENDIX 1.** (Continued).

Family	Scientific name	Life form/ Growth strategy	Study plot reference number <sup>1</sup>															Voucher <sup>2</sup>
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	
Combretaceae	<i>Terminalia calamansanay</i> Rolfe	Ptt							5	3								Patt. 557
Convolvulaceae	<i>Aniseia martinicensis</i> (Jacq.) Choisy	Atv	1			1	1	1	1	1		1	1	1	1	1		Patt. 236
	<i>Merremia hirta</i> (L.) Merr.	Atv	1									1		1				Patt. 244
Dilleniaceae	<i>Dillenia hookeri</i> Pierre	Ptu														1		Patt. 401
	<i>Tetracera loureiri</i> (Finet & Gagnep.) Pierre ex Craib	Ptw				3			3	3	3	3		3	3	3		Patt. 337
Droseraceae	<i>Drosera indica</i> L.	Aaem			4													Patt. 374
Euphorbiaceae	<i>Croton caudatus</i> Geiseler	Pts							4				3		2	4		Patt. 215
	<i>Shirakiopsis indica</i> (Willd.) Esser	Pa/tt							3									Patt. 358
Fabaceae	<i>Acacia pennata</i> Willd.	Pts													3			Patt. 567
	<i>Aeschynomene indica</i> L.	Pas				3												
	<i>Adenanthera pavonina</i> L.	Pts														5		Patt. 456
	<i>Caesalpinia crista</i> L.	Ptv																
	<i>Derris elliptica</i> (Roxb.) Benth.	Ptw							2							3		
	<i>Derris heptaphylla</i> Merr.	Ptu																
	<i>Derris scandens</i> (Roxb.) Benth.	Pa/tw							2			2						
	<i>Derris sp</i>	Pa/tw							3									Patt. 461
	<i>Flemingia macrophylla</i> (Willd.) Prain	Ptu														3		Patt. 566

**APPENDIX 1.** (Continued).

Family	Scientific name	Life form/ Growth strategy	Study plot reference number <sup>1</sup>															Voucher <sup>2</sup>
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	
Fabaceae	<i>Flemingia strobilifera</i> (L.) W.T. Aiton	Ptu											2			3		Patt. 197
	<i>Mucuna gigantea</i> (Willd.) DC.																	Patt. 400
	<i>Senna timoriensis</i> (DC.) H.S. Irwin & Barneby	Pts																
	<i>Sesbania javanica</i> Miq.	Pas											3					Patt. 381
Hydrophyllaceae	<i>Hydrolea zeylanica</i> (L.) Vahl	Aaem										1						Patt. 176
Lamiaceae	<i>Clerodendrum paniculatum</i> L.	Pts								*								
	<i>Glossocarya linnaei</i> Benth. & Hook. f.	Pts						2										Patt. 348
	<i>Premna annulata</i> Fletcher	Ptw											2					Patt. 244-1
	<i>Vitex glabrata</i> R.Br.	Ptt								4								Patt. 260
Lecythidaceae	<i>Barringtonia acutangula</i> (L.) Gaertn.	Ptt					7	5	7	3	3	6	4	4				Patt. 196
	<i>Barringtonia racemosa</i> (L.) Spreng.	Ptt																Patt. 351
Lentibulariaceae	<i>Utricularia auria</i> Lour.	Aaff										1						
	<i>Utricularia bifida</i> L.	Aaem			6													Patt. 288
	<i>Utricularia caerulea</i> L.	Aaem			5													Patt. 373
Loranthaceae	<i>Macrosolen cochinchinensis</i> (Lour.) Tiegh.	Pte								1								Patt. 194
Lythraceae	<i>Lagerstroemia floribunda</i> Wall.	Ptt								8		7			4	8		Patt. 362

**APPENDIX 1.** (Continued).

Family	Scientific name	Life form/ Growth strategy	Study plot reference number <sup>1</sup>															Voucher <sup>2</sup>	
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15		
Lythraceae	<i>Lagerstroemia. speciosa</i> (L.) Pers.	Ptt						8	4										Patt. 246
	<i>Sonneratia caseolaris</i> (L.) Engl.	Pat																	
Melastomataceae	<i>Melastoma malabathricum</i> L.	Pts							3	1			3	2					Patt. 189
Moraceae	<i>Ficus hispida</i> L.f.	Pts						3	4										
	<i>Maclura cochinchinensis</i> (Lour.) Corner	Ptc							2										Patt. 261
	<i>Streblus asper</i> Lour.	Pts						5	3	7	7						8		Patt. 227
	<i>Streblus perakensis</i> Corner	Pts						3											Patt. 223
Malvaceae	<i>Melochia corchorifolia</i> L.	Ath	1						1				2						Patt. 275
	<i>Microcos tomentosa</i> Sm.	Pts								3				3	3		3		Patt. 344
	<i>Pantapetes phoenicea</i> L.	Aaem											3						Patt. 167
	<i>Sida rhombifolia</i> L.	Ptu							2										Patt. 462
	<i>Urena lobata</i> L.	Ptu							4			2	2		2				Patt. 239
Myrtaceae	<i>Syzygium</i> sp.	Ptt								4									Patt. 355
Olacaceae	<i>Olex scandens</i> Roxb.	Ptw								2							2		Patt. 241
Onagraceae	<i>Ludwigia hyssopifolia</i> (G. Don) Exell	Aaem						2											
	<i>Ludwigia octovalvis</i> (Jacq.) P.H. Raven	Aaem	2			3	2					2	1	1					
Phyllanthaceae	<i>Antidesma ghaesembilla</i> Gaertn.	Pts							6	5	7			1	6	7			Patt. 193

**APPENDIX 1.** (Continued).

Family	Scientific name	Life form/ Growth strategy	Study plot reference number <sup>1</sup>															Voucher <sup>2</sup>	
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15		
Phyllanthaceae	<i>Breynia vitis-idaea</i> (Burm.f.) C.E.C. Fisch.	Pts								1	1				1	1	1	Patt. 195	
	<i>Bridelia sp.</i>	Pts														2		Patt. 272	
	<i>Flueggea virosa</i> (Willd.) Voigt	Pts						3	3				2	*				Patt. 437	
	<i>Glochidion obscurum</i> Blume	Pts																	
	<i>Glochidion rubrum</i> Blume	Pts						2	3	3			5	3	7	7	3	Patt. 183	
	<i>Hymenocardia punctata</i> Wall.	Pa/ts						3	5	5	3				4	4	3	Patt. 218	
	<i>Sauropus rostratus</i> Miq.	Ptu												*				Patt. 273	
	<i>Phyllanthus reticulatus</i> Poir.	Pts							1									Patt. 438	
	<i>Phyllanthus urinaria</i> L.	Ath	*																Patt. 424
Polygalaceae	<i>Salomonina longiciliata</i> Kurz	Aaem			3													Patt. 375	
	<i>Xanthophyllum eurhynchum</i> Miq.	Pts							2									Patt. 221	
Polygonaceae	<i>Persicaria attenuata</i> (R.Br.) Soják	Aaem		2		3						4	3					Patt. 174	
Ranunculaceae	<i>Naravelia dasyoneura</i> Korth.	Ptv						2										Patt. 225	
Rhamnaceae	<i>Ziziphus oenopolia</i> (L.) Mill.	Pts								3	6	5			3	3	5	6	Patt. 180
Rubiaceae	<i>Borreria alata</i> (Aubl.) DC.	Ath		5															
	<i>Canthium horridum</i> Blume	Pts							2	2					1			Patt. 182	
	<i>Hedyotis herbacea</i> L.	Ath										2						Patt. 409	
	<i>Kailarsenia campanula</i> (Ridl.) Tirveng.	Ptc						3										Patt. 214	
	<i>Meyna sp.</i>	Pts														3	2	Patt. 269	

**APPENDIX 1.** (Continued).

Family	Scientific name	Life form/ Growth strategy	Study plot reference number <sup>1</sup>															Voucher <sup>2</sup>
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	
Rubiaceae	<i>Mitragyna diversifolia</i> Havil.	Ptt							3	3		9	9	8	8	6		Patt. 231
	<i>Morinda elliptica</i> Ridl.	Ptt						2	2				1		3			Patt. 228
	<i>Nauclea orientalis</i> L.	Ptt						6										Patt. 441
	<i>Paederia foetida</i> L.	Atv							2	2			2					Patt. 472
	<i>Tamilnadia uliginosa</i> (Retz.) Tirveng. & Sastre	Ptt												2	4	2		Patt. 245
Salicaceae	<i>Homalium caryophyllaceum</i> Benth.	Ptt																
Sapindaceae	<i>Allophylus cobbe</i> (L.) Raeusch.	Pts								3	3			3		3		Patt. 285
	<i>Lepisanthes rubiginosa</i> (Roxb.) Leenh.	Ptt													1			Patt. 190
Scrophulariaceae	<i>Limnophila erecta</i> Benth.	Aaem										2						Patt. 411
	<i>Limnophila laxa</i> Benth.	Ath			3													Patt. 507
	<i>Lindernia ciliata</i> (Colsm.) Pennell	Aaem														2		Patt. 372
	<i>Lindernia crustacea</i> (L.) F. Muell.	Aaem		4	3											2		Patt. 433
Stylidiaceae	<i>Stylidium tenellum</i> Sw. ex Willd.	Aaem			3													Patt. 508
Urticaceae	<i>Pouzolzia zeylanica</i> (L.) Benn.	Ath	3												2			Patt. 563
Vitaceae	<i>Leea rubra</i> Blume	Pts						3	3	3	2	5	3	4	6			Patt. 264
Vitaceae	<i>Leea indica</i> (Burm. f.) Merr.	Pts																Patt. 359

**APPENDIX 1.** (Continued).

Family	Scientific name	Life form/ Growth strategy	Study plot reference number <sup>1</sup>															Voucher <sup>2</sup>
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	
<b>MAGNOLIIDS</b>																		
Annonaceae	<i>Uvaria rufa</i> Blume	Ptw						3		4	3			3		3	Patt. 262	
Laurceae	<i>Litsea</i> sp.	Ptt								4							Patt. 343	
<b>MONOCOTS</b>																		
Alismataceae	<i>Limnocharis flava</i> Buchenau	Aaem				1						3					Patt. 173	
Araceae	<i>Cryptocoryne ciliata</i> (Roxb.) Fisch. ex Wydl.	Paem																
	<i>Lasia spinosa</i> (L.) Thwaites	Pag						2										
	<i>Typhonium flagelliforme</i> (Lodd.) Blume	Aaem								1	1			2	2	1	Patt. 204	
Amaryllidaceae	<i>Crinum amoenum</i> Roxb.	Pag								1	1			2	2		Patt. 184	
Commelinaceae	<i>Commelina diffusa</i> Burm.f.	Pth	1	1		1	2					1	1			1	Patt. 387	
	<i>Cyanotis axillaris</i> (L.) D. Don ex Sweet.	Pth	1	1		1	2					1	1			1	Patt. 232	
	<i>Murdannia nudiflora</i> (L.) Brenan	Pth	2	2	2												Patt. 388	
Cyperaceae	<i>Actinoscirpus grossus</i> (L.f.) Goetgh. & D.A. Simpson	Paem				10	8					1					Patt. 401	
	<i>Cyperus babakan</i> Steud.	Paem	3	2	2							1	2				Patt. 405	
	<i>Cyperus compactus</i> Lam.	Paem	1									1		*			Patt. 186	
	<i>Cyperus digitatus</i> Roxb.	Paem		1	2							1					Patt. 403	
	<i>Cyperus elatus</i> L.	Paem		1			1										Patt. 449-1	
	<i>Cyperus haspan</i> L.	Aaem	4	1	5		2					3	3	2	3	2	Patt. 175	

**APPENDIX 1.** (Continued).

Family	Scientific name	Life form/ Growth strategy	Study plot reference number <sup>1</sup>															Voucher <sup>2</sup>		
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15			
Cyperaceae	<i>Cyperus iria</i> L.	Aaem																		
	<i>Cyperus imbricatus</i> Retz.	Paem		1																Patt. 449-2
	<i>Cyperus pilosus</i> Vahl	Aaem	4	5					1											Patt. 429
	<i>Cyperus pulcherrimus</i> Willd. ex Kunth	Aaem	3	5	4							3	2	2			2			Patt. 419
	<i>Eleocharis acutangula</i> (Roxb.) Schult.	Paem	6																	Patt. 428
	<i>Fimbristylis acuminata</i> Vahl	Ath			7												2			Patt. 485
	<i>Fimbristylis miliacea</i> (L.) Vahl	Aaem	8	3	7							3		2	3		2			Patt. 406
	<i>Fimbristylis schoenoides</i> Vahl	Aaem			8													3		Patt. 436-2
	<i>Fimbristylis tetragona</i> R.Br.	Paem	3																	Patt. 475
	<i>Fimbristylis umbellaris</i> (Lam.) Vahl	Paem	6	3		2												2		Patt. 422
	<i>Kyllinga brevifolia</i> Rottb.	Ath	2	6	1							2								Patt. 446
	<i>Lipocarpa microcephala</i> (R.Br.) Kunth	Ath			4															Patt. 480
	<i>Pycneus flavidus</i> (Retz.) T. Koyama	Aaem			3															Patt. 483
	<i>Pycneus polystachyos</i> (Rottb.) P. Beauv.	Aaem		3																Patt. 492
	<i>Rhynchospora corymbosa</i> (L.) Britton	Paem	2		2	3	4					2								Patt. 402
	<i>Rhynchospora rubra</i> (Lour.) Makino	Ath															1			Patt. 454

**APPENDIX 1.** (Continued).

Family	Scientific name	Life form/ Growth strategy	Study plot reference number <sup>1</sup>															Voucher <sup>2</sup>	
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15		
Cyperaceae	<i>Scleria poiformis</i> Retz.	Paem	5									2		2					Patt. 423
Dioscoreaceae	<i>Dioscoria</i> sp.	Ptv														1			Patt. 568
Eriocaulaceae	<i>Eriocaulon truncatum</i> Buch.-Ham. ex Mart.	Aaem			4														Patt. 481
	<i>Eriocaulon xeranthemum</i> Mart.	Aaem			4														Patt. 499
Flagellariaceae	<i>Flagellaria indica</i> L.	Ptv					2	2						1				2	Patt. 226
Hydrocharitaceae	<i>Ottelia alismoides</i> (L.) Pers.	Aasa				2							2						Patt. 504
Liliaceae	<i>Gloriosa superba</i> L.	Ptv										2						2	2
Marantaceae	<i>Schumannianthus dichotomus</i> Gagnep.	Paem					3	5					3	3					
Orchidaceae	<i>Dendrobium crumenatum</i> Sw.	Pte							2										
	<i>Micropera pallida</i> Lindl.	Pte							2					2					Patt. 385
	<i>Thrixspermum leucarachne</i> Rild.	Pte													*				Patt. 346
Poaceae	<i>Aerides</i> sp.	Pte						1											
	<i>Cynodon dactylon</i> (L.) Pers.	Ath		7														2	Patt. 489
	<i>Echinochloa colona</i> (L.) Link	Ath	5																Patt. 506
	<i>Eragrostis</i> sp.	Ath		*															Patt. 450
	<i>Hymenachne acutigluma</i> (Steud.) Gilliland	Aaem	5	5										3					Patt. 447
	<i>Isachne globosa</i> Kuntze	Ath	4																Patt. 505



**APPENDIX 1.** (Continued).

Family	Scientific name	Life form/ Growth strategy	Study plot reference number <sup>1</sup>															Voucher <sup>2</sup>
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	
Poaceae	<i>Ischaemum rugosum</i> Salisb.	Aaem	2															Patt. 426
	<i>Oryza rufipogon</i> Griff.	Aaem	*															
	<i>Panicum</i> sp.	Ath		5									2					Patt. 280
	<i>Paspalum conjugatum</i> P.J. Bergius	Ath		8														Patt. 445
	<i>Paspalum longifolium</i> Roxb.	Ath		3								*	3	2	1			Patt. 233
	<i>Paspalum scrobiculatum</i> L.	Ath	2															Patt. 391
	<i>Sacciolepis indica</i> (L.) Chase	Ath	3															Patt. 469
	Pontederiaceae	<i>Monochoria hastata</i> Solms	Aaem				5											
Pontederiaceae	<i>Monochoria vaginalis</i> (Burm. f.) C. Presl ex Kunth	Aaem		2								2						Patt. 407
Smilacaceae	<i>Smilax</i> sp .	Ptv							1						1			
Stemonaceae	<i>Stemona</i> sp .	Ptv									2						2	Patt. 354
Xyrisdaceae	<i>Xyris indica</i> L.	Aaem	2															Patt. 188
	<i>Xyris pauciflora</i> Willd.	Aaem	2															Patt. 187

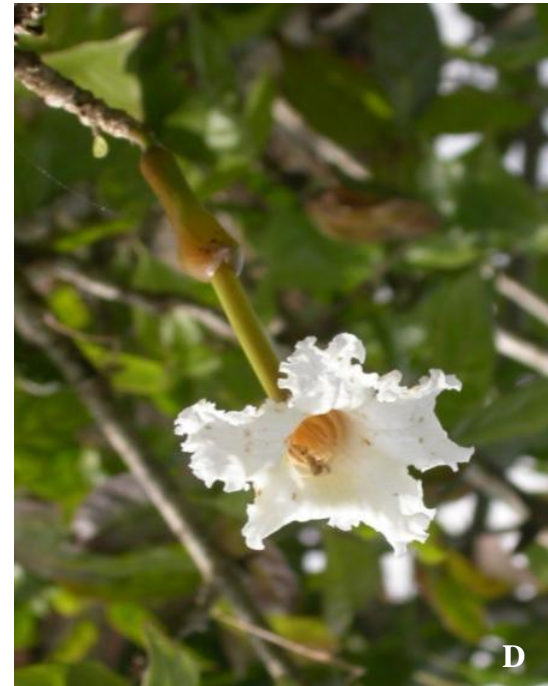
## **COLOUR PLATES**



**Plate 1.** A. *Actinoscirpus* grassland (KY1); B. *Eleocharis-Fimbristylis* grassland (NT6) and *Lagerstroemia-Streblus-Ziziphus* shrubland on the termite mounds (NT4); C. *Paspalum-Cynodon-Hymenachene* grassland (KP1); D. *Barringtonia-Lagerstroemia-Nauclea* woodland (KP3); E.–F. *Mitragyna* shrubland (NT1) and (KP2); G.–H. *Mitragyna-Lagerstroemia-Glochidion* shrubland (NT5) and (BR1).



**Plate 2.** A. *Lygodium microphyllum* R.Br.; B. *Drynaria quercifolia* (L.) J. Sm; C.–D. *Pyrrosia piloselloides* (L.) M.G. Price; E. *Alternanthera sessilis* (L.) DC.; F. *Aganosma marginata* G. Don; G. *Ichnocarpus frutescens* (L.) W.T. Aiton; H. *Wrightia religiosa* Benth. & Hook.f.



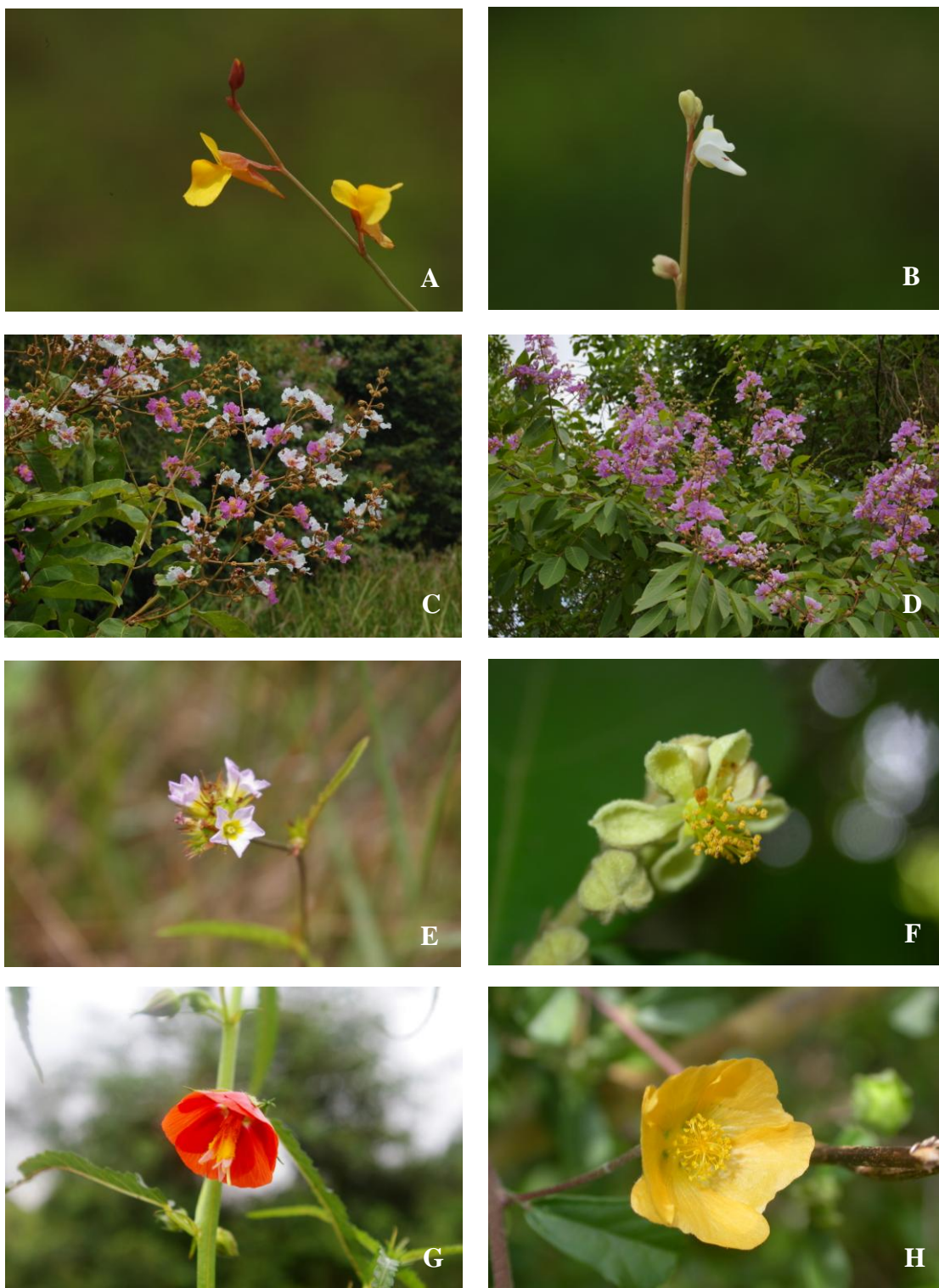
**Plate 3.** A. *Eclipta prostrata* (L.) L.; B. *Hydrocera triflora* (L.) Wight & Arn.; C.–D. *Dolichandrone columnaris* Santisuk; E. *Heliotropium indicum* L.; F. *Lobelia alsinoides* Lam.



**Plate 4.** A. *Combretum trifoliatum* Vent.; B. *Terminalia calamansanay* Rolfe; C. *Aniseia martinicensis* (Jacq.) Choisy; D. *Dillenia hookeri* Pierre; E. *Tetracera loureiri* (Finet & Gagnep.) Pierre ex Craib; F. *Drosera indica* L.; G. *Croton caudatus* Geiseler; H. *Derris elliptica* Benth.



**Plate 5.** A. *Mucuna gigantea* (Willd.) DC.; B. *Hydrolea zeylanica* (L.) Vahl; C. *Clerodendrum paniculatum* L.; D. *Glossocarya linnaei* Benth. & Hook.f.; E. *Premna annulata* H.R. Fletcher; F. *Vitex glabrata* R.Br.; G. *Barringtonia acutangula* (L.) Gaertn.; H. *Barringtonia racemosa* (L.) Spreng.

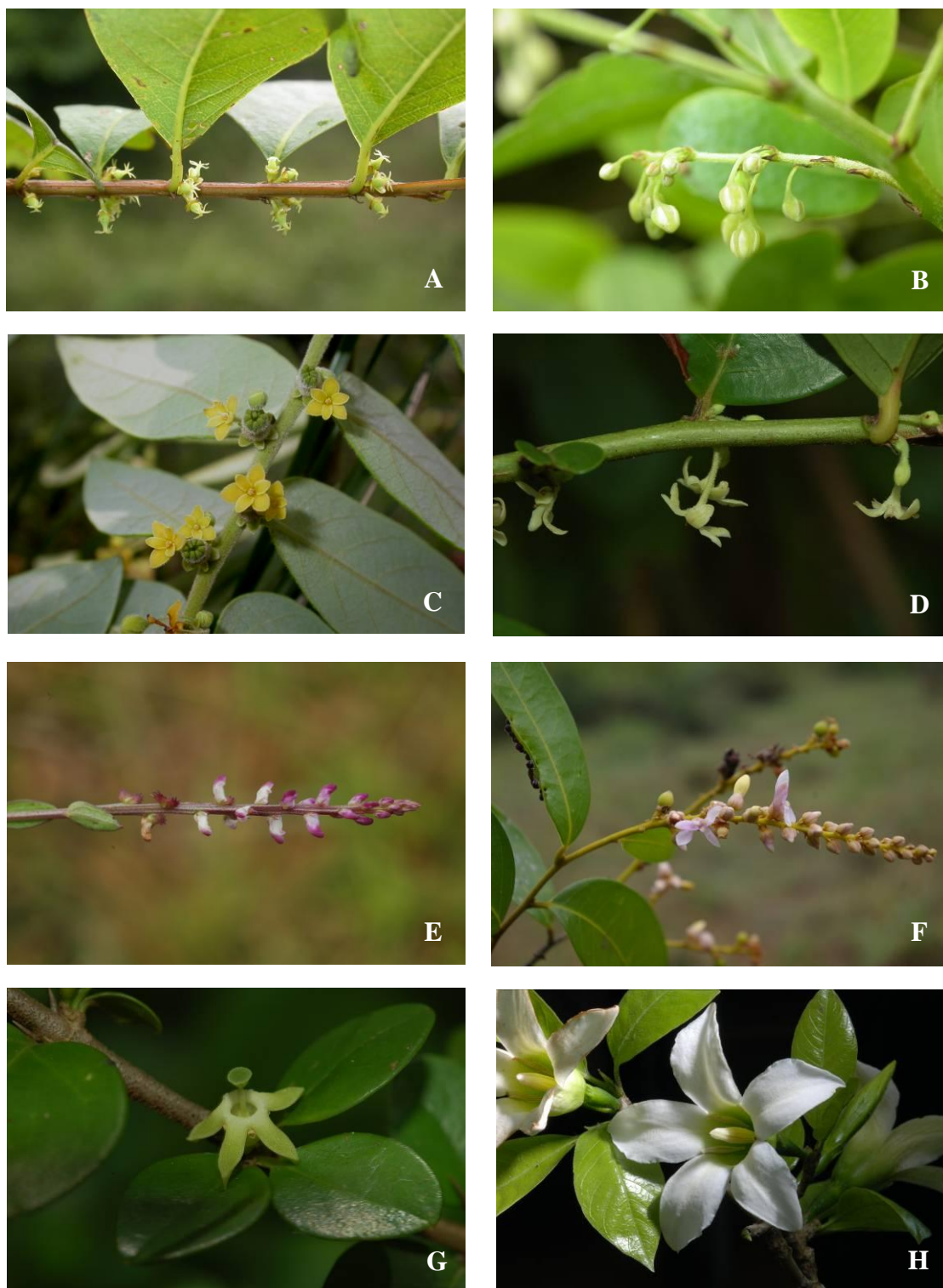


**Plate 6.** A. *Utricularia bifida* L.; B. *Utricularia caerulea* L.; C. *Lagerstroemia floribunda* Jack; D. *Lagerstroemia speciosa* Pers.; E. *Melochia corchorifolia* L.; F. *Microcos tomentosa* Sm.; G. *Pentapetes phoenicea* L.; H. *Sida rhombifolia* L.

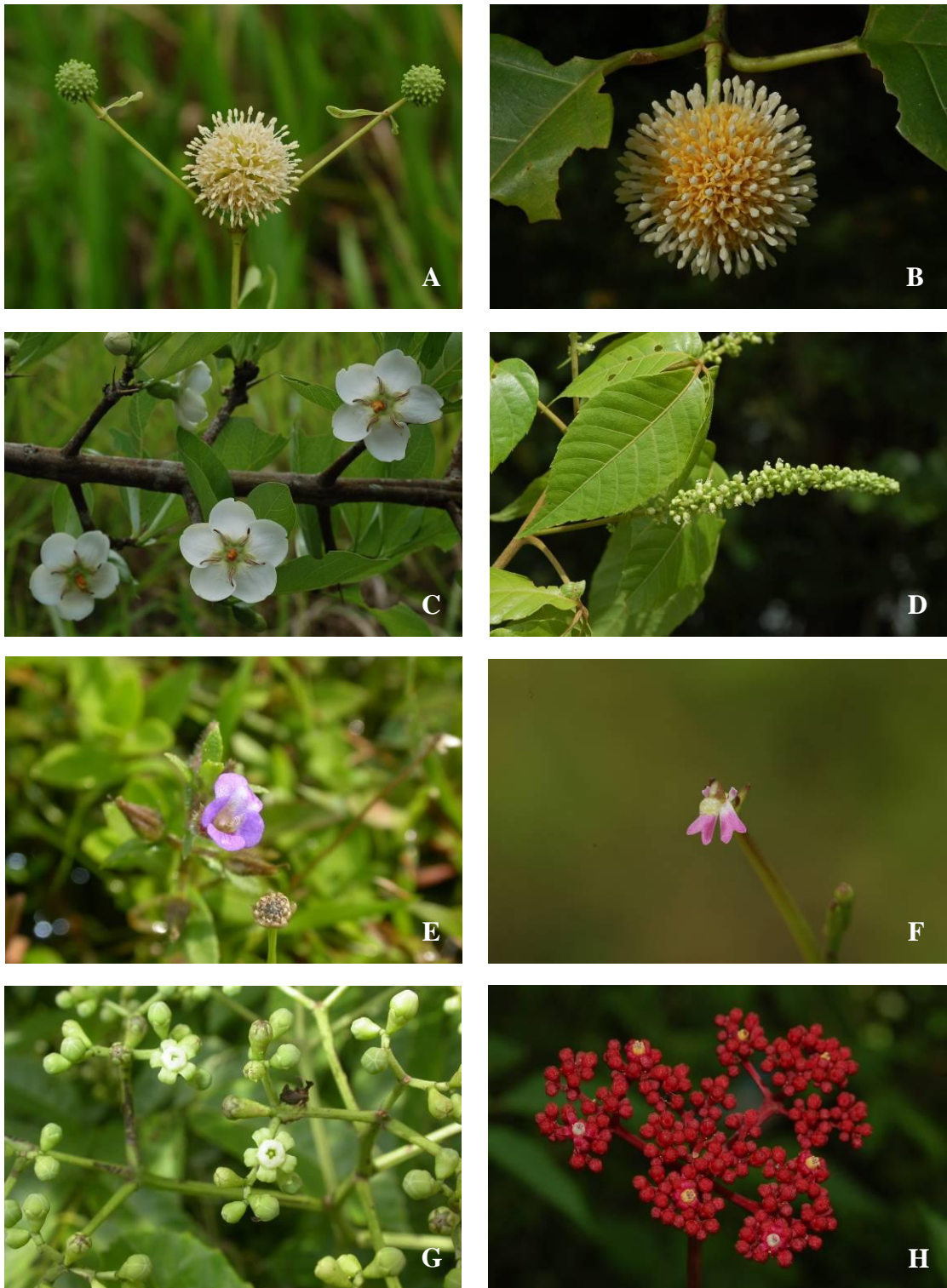




**Plate 7.** A. *Urena lobata* L.; B. *Melastoma malabathricum* L. subsp. *malabathricum*; C. *Streblus asper* Lour.; D. *Streblus perakensis* Corner; E. *Olax psittacorum* Vahl; F.–G. *Antidesma ghaesembilla* Gaertn.; H. *Breynia vitis-idaea* (Burm.f.) C.E.C. Fisch.



**Plate 8.** A.–B. *Flueggea virosa* (Roxb. ex Willd.) Royle; C. *Glochidion obscurum* Blume; D. *Glochidion rubrum* Blume; E. *Salomonina longiciliata* Kurz; F. *Xanthophyllum eurhynchum* Mig.; G. *Canthium horridum* Blume; H. *Kailarsenia campanula* (Ridl.) Tirveng.



**Plate 9.** A. *Mitragyna diversifolia* (Wall. ex G. Don) Havil.; B. *Nauclea orientalis* (L.) L.; C. *Tamilnadia uliginosa* (Retz.) Tirveng. & Sastre; D. *Allophylus cobbe* (L.) Raeusch.; E. *Linnophila laxa* Benth.; F. *Stylidium tenellum* Sw. ex Willd.; G. *Leea indica* (Burm.f.) Merr.; H. *Leea rubra* Blume ex Spreng



**Plate 10.** A. *Uvaria rufa* Blume; B. *Typhonium flagelliforme* (Lodd.) Blume; C. *Cryptocoryne ciliata* (Roxb.) Fisch. ex Wydler; D. *Commelina diffusa* Burm.f.; E. *Cyanotis axillaris* (L.) D. Don ex Sweet; F. *Murdannia nudiflora* (L.) Brenan



**Plate 11.** A. *Actinoscirpus grossus* (L.f.) Goetgh. & D.A.Simpson; B. *Cyperus babakan* Steud.; C. *Cyperus compactus* Retz.; D. *Cyperus digitatus* Roxb.; E. *Cyperus elatus* L.; F. *Cyperus imbricatus* Retz.; G. *Cyperus pilosus* Vahl; H. *Cyperus pulcherrimus* Willd. ex Kunth



**Plate 12.** A. *Fimbristylis tetragona* R.Br.; B. *Kyllinga brevifolia* Rottb.; C. *Eleocharis acutangula* (Roxb.) Schult.; D. *Scleria poiformis* Retz.; E. *Rhynchospora rubra* (Lour.) Makino; F. *Flagellaria indica* L.



**Plate 13.** A. *Gloriosa superba* L.; B. *Schumannianthus dichotomus* Gagnep.; C. *Micropera pallida* (Roxb.) Lindl.; D. *Thrixspermum leucarachne* Ridl.; E. *Echinochloa colona* (L.) Link; F. *Hymenachne acutigluma* (Steud.) Gilliland



**Plate 14.** A. *Ischaemum rugosum* Salisb.; B. *Paspalum longifolium* Roxb; C. *Isachne globosa* Kuntze; D. *Paspalum conjugatum* P.J. Bergius; E. *Sacciolepis indica* Chase; F. *Monochoria hastata* (L.) Solms



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- The TRF/BIOTEC Special Program for Biodiversity Research and Training grant BRT T152100 (BRT)

### List of Publication and Proceedings

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