CHAPTER 1

GENERAL INTRODUCTION

1.1 Introduction

The family Convolvulaceae comprises 56 genera and about 1,840 species (Staples & Brummitt in Heywood *et al*., 2007). This family occurs throughout the tropical and warm temperate regions. They grow as climbers, herbaceous, shrubs, and rarely trees. The climbers twine in an anti-clockwise direction and they are recognized by the absence of tendrils, hooks or other climbing aids. They have simple (or compound) alternate leaves along the stem, the corolla is often trumpet- or bell-shaped, usually 5-merous and milky sap is present but not in all species. Even though the family is well known for weedy plants (e.g. *Calystegia*, *Cuscuta* and *Convolvulus*), many species are valuable as medicinals (e.g. *Convolvulus*, *Erycibe*, *Ipomoea*, *Cuscuta* and *Merremia*), food crops (e.g. *Ipomoea batatas*, *I. aquatica*) and are being used as ornamentals in the landscape (e.g. *Argyreia*, *Evolvulus*, *Ipomoea* and *Merremia*).

The genus *Erycibe* was first described by Roxburgh in 1802, based on *E. paniculata* from India (Fig. 1.1). The generic name *Erycibe* is derived from the Greek word “erusibe” meaning mildew, and is believed referring to the trichome appearance.

Species of *Erycibe* are woody climbers or lianas or small shrubs that climb by twining and depend more on physical entanglement of their branches with nearby vegetation. It had been reported that the process of entanglement is aided by the growth of branches at different angles (Ng, 1989). Milky sap is not present in this genus. Many *Erycibe* have sweetly scented flowers like jasmine, majority with very light odor. *Erycibe* can be recognized by the absence of the style, bifid corolla lobes, having very dense hair (usually brown or copper colour) on midpetaline bands, and having a berry-like fruit, which is seated on the persistent calyx. These characters have been used to

distinguish *Erycibe* from other genera in the family. *Erycibe* is typically found in forest margins, forest gaps and near the roadsides; any gaps where sunlight is available and in dense forest on top of canopy tree.

Fig. 1.1. Type of *Erycibe paniculata* from India. (Source: Roxburgh, W. (1802) [t.p. 1798]. *Plants of the Coast of Coromandel* 2: 31–32. Plate 159.)

Genus *Erycibe* with distributional range from western India and Sri Lanka across tropical and subtropical Asia as far east as the Philippines and southernmost Japan (Yakushima Island) and south through Malesia as far as Timor, New Guinea and the northern tip of Queensland, Australia (Hoogland, 1953a) (Fig. 1.2). The genus has about 75 species and is centered in South East Asia and Malesia (Staples, 2010).

In term of classification and taxonomy, Malaysian *Erycibe* had been documented by Clarke (1883), Hallier (1893, 1897), Prain (1894, 1896, 1903, 1906), Ridley (1923), Hoogland (1953a, 1953b), and Ng (1989). Among the revisions, Hoogland (1953a, 1953b), did a comprehensive work and recorded seventeen taxa in Peninsular Malaysia. His taxonomic key relies on reproductive (floral) characters and is not practical for sterile or fruiting material and most of his descriptions were mainly based on the herbarium specimens available at the time. After about 36 years later, Ng (1989), in the *Tree Flora of Malaya*, he recognized two more taxa for Peninsular Malaysia, but named only as sp. A and sp. B. However, these two taxa have not been described hitherto due to incomplete materials. In total, at present, Peninsular Malaysia has nineteen taxa recognized.

Almost six decades after Hoogland's work (1953a), there was no updated taxonomic revision for the genus *Erycibe* in Peninsular Malaysia. The most recent account for Peninsular Malaysia is by Ng (1989), but only cursory account is available. With many more Malaysian collections of *Erycibe* available at the present, it is possible to review and re-examine the taxonomic concepts and to reassess the geographical distributions of the genus in Peninsular Malaysia.

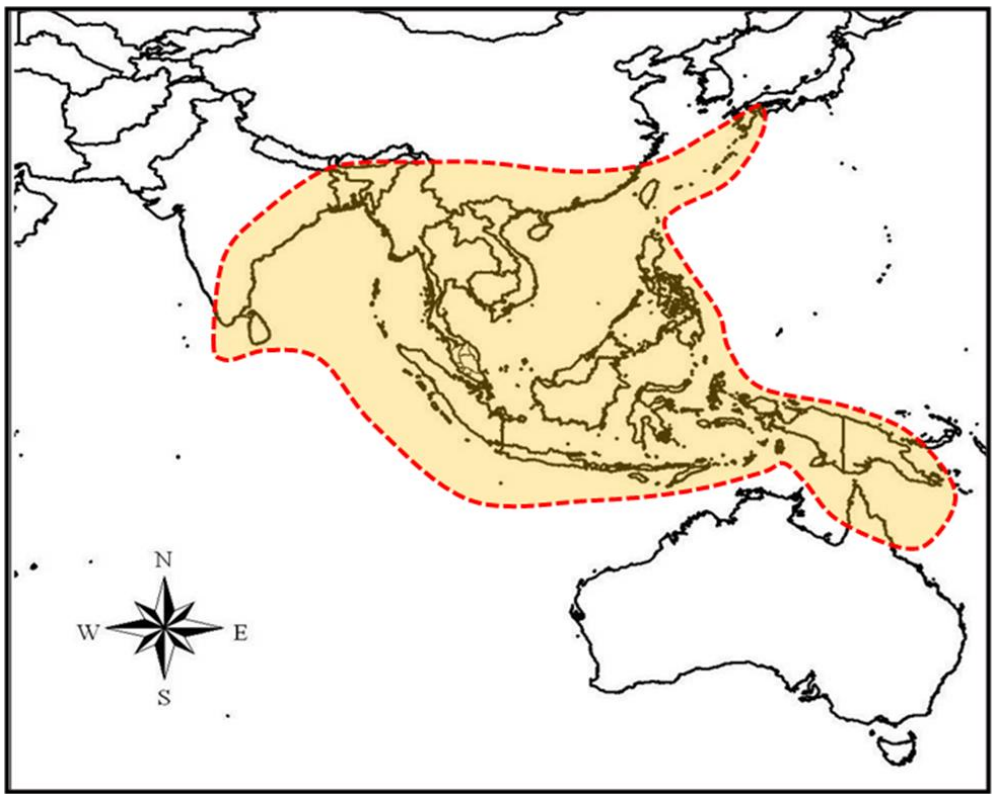

Fig. 1.2. Distribution of the genus *Erycibe.*

1.2 Scope of Research

The study aimed to revise the taxonomy of the genus *Erycibe* occurring in Peninsular Malaysia. The study was largely based on the examination of more than 170 herbarium specimens of *Erycibe* species collected from various localities in Peninsular Malaysia. Herbarium specimens were studied from the herbaria of BKF, BM, K, KEP, KLU, L, SING and UKMB.

Nine field trips were also carried out (from the year 2009–2010) at known localities as well as new areas, while specialised trips were carried out to relocate rare species. The targets were to obtain fresh materials and to make direct observations on living plants. Flowers and fruits were preserved in spirit to maintain the gynoecium and androecium parts. Information on the habitat and habit characters was based on personal observations made in the field. In addition, photographs of specimens, especially the

flowers and fruits, were taken as additional documentation for distinguishing the species.

This study focused primarily on morphological aspect, both on vegetative and reproductive characters and also the characters of trichome structures particularly on the calyx and midpetaline bands (Chapter 3). Scanning electron microscopy (SEM) technique was used to see the trichomes characters, and to determine whether trichomes are good taxonomic characters in delimiting species. Trichome types were also described in more detail and classified into specific groups. The micrographs images produced from the SEM will beneficially become a reference in the future study.

Based on the morphological data sets obtained in the present study, a detailed taxonomic revision of the recognised species occurring in Peninsular Malaysia was prepared. List of specimens identified is also provided (Chapter 4).

This study also aimed to get a better understanding of the geographical distribution and to assess the level of threat and conservation status of each taxon (Chapter 5). Distribution map was prepared for each taxon using software ArcView GIS 3.2a, while the conservation status for each species was assessed based on the guidelines and criteria proposed in *Malaysia Plant Red List* (Chua & Saw, 2006).

1.3 Objectives of the study

The main objectives of the study were:

- To revise the genus *Erycibe* in Peninsular Malaysia based on morphological characters.
- To carry out an SEM study of trichome structures on the calyx and midpetaline bands to assess their values in delimiting species.

- To provide detailed descriptions of the species and user-friendly key to identify Peninsular Malaysian species.
- To establish the geographical distribution and assess conservation status for *Erycibe* in Peninsular Malaysia.

CHAPTER 2

LITERATURE REVIEW

2.1 Recognizing *Erycibe* from other genera or families

It has been problematic for curators and collectors to distinguish sterile or even fruiting specimens of *Erycibe* in the forest as well as in the herbarium. In the absence of flowers, the genus lacks simple diagnostic characters and hardly recognized as Convolvulaceae. A few sterile or fruiting herbarium specimens were misidentified or confused with other genera from other families such as *Diospyros* (Ebenaceae), Icacinaceae, Olacaceae and *Embelia* (Myrsinaceae) since this genus lacks simple diagnostic character that can assign sterile specimens to the genus *Erycibe* (Utteridge, T.M.A., *pers. comm*.). However, there are few characters that can be used to locate specimens of *Erycibe* in the correct genus.

Erycibe has persistent and neatly overlapping calyx lobes at the base of the fruit. Most Malaysian species (except *E. albida*) have hairy calyx and these characters (overlapping sepals and hairy calyx) are very useful. In the treelet and shrub group (*E. albida, E. borneensis* and *E. bullata* group), with dry pale green laminas, are always with holes on the laminas because leaves are eaten by caterpillars (observation on majority of the herbarium collections and personal observation at field).

Based on the berry-like fruit which is single seeded and the vague leaf venation (in some species), *Erycibe* species are usually confused with species from the families Icacinaceae and Olacaceae (Utteridge, T.M.A., *pers. comm*.).

In few Malaysian species (e.g. *E. albida* and *E. magnifica* group) the leaf margin are rolled backward (revolute). The thin (*E. albida*) and thick dry leaves (*E. magnifica*) are revolute along the margin and this character has also been observed in many dry

leaves of Icacinaceae. However, Icacinaceae and Olacaceae sometimes have a cup-like calyx and the climbing Icacinaceae either have opposite or palmate leaves or large and complex inflorescences (Utteridge, T.M.A., *pers. comm.*).

Erycibe can be distinguished from *Diospyros* (Ebenaceae) although both have persistent calyx and some *Erycibe* species have leaves which are often dark when dry (*E. rheedii*, *E. magnifica*). Nevertheless, the calyx lobes of Ebenaceae do not overlap and glands are present on the adaxial surface of the leaves (Utteridge, T.M.A., *pers. comm.*).

Embelia (Myrsinaceae) is exclusively a liana or woody climber, which is similar to most *Erycibe* species (Utteridge, T.M.A., *pers. comm.*). However, *Embelia* has entire or toothed leaf margins. The flowers of *Embelia* are smaller compared to *Erycibe* and there are notched anthers with glands on the connective in *Embelia* (personal observation).

2.2 Taxonomic position of *Erycibe*

Traditionally, the classification for the family Convolvulaceae has been assigned to tribes based on their morphological characters (Endlicher, 1841; Bentham, 1846; Hallier, 1893).

In 1798, the genus *Erycibe* was first described by Roxburgh in *Plants of the Coast of Coromandel.* It was based on the specimen *E. paniculata* from India, now considered as the type species for the genus.

Early botanist, Augustin Pyrame De Candolle and his son, Alphonse, (before year 1845), were unsured of the position of Erycibeae and tried to relate it with other families. Augustin Pyrame De Candolle indicated that Erycibeae resembles Convolvulaceae and Cordieae in the number of calyx parts, the corolla, stamens and

plicate cotyledons, but differs from the Convolvulaceae by the baccate (berry-like and soft) fruit, and from the Cordieae by the imbricate corolla aestivation. Erycibeae differs from other families by the absence of style, the bipartite (bifid) corolla lobes, and five stigmas (actually referring to 5-ridged stigma apex). As a result of these differences, he thought Erycibeae perhaps can be placed near the Ebenaceae and Aquifoliaceae.

Later, Alphonse De Candolle published volume nine of the *Prodromus* (De Candolle, 1845) with modifications of his father's account. He interpreted these characters differently, made additional and detailed observations on the flower parts. In his opinion Erycibeae differs from the Convolvulaceae not by the baccate fruit (fruits are occasionally baccate in Convolvulaceae), but by the lack of style, the stigmas radiating like a poppy, and especially by the unilocular ovary. However, the corolla aestivation of Erycibeae is in duplicate and the outside of the lobes is more or less contorted similar the Convolvulaceae but different from the aestivation of Cordieae. On the other hand, the calyx, ovary and erect anatropous ovules are similar to *Monotheca* (formerly Theophrastaceae, now Sapotaceae), but the corolla aestivation, position of the stamens, and number of ovules are different. Alphonse De Candolle concluded that Erycibeae was not so different from Convolvulaceae and placed it between Convolvulaceae and Cordieae (Boraginaceae).

In 1841, Endlicher introduced the tribe Erycibeae for the single genus *Erycibe*. Bentham (1846) added another two genera, *Dicranostyles* Benth. and *Lysiostyles* Benth. into the same tribe. Later, Hallier (1893) added the genera, *Maripa* Aubl. and *Humbertia* Lam. in the tribe Erycibeae which has entire or no style and indehiscent, large, woody or fleshy fruit. At the same time, Hallier (1893) also divided Convolvulaceae into two informal groups without taxonomic rank: Psiloconiae (smooth pollen surface) and Echinoconiae (spiny pollen surface). These groups are subdivided into several tribes and *Erycibe* was placed under the tribe Erycibeae in Psiloconiae

group. Hallier's concept has been followed by Austin (1973, 1998) and Deroin (1992). Van Ooststroom & Hoogland (1953), in their account for *Flora Malesiana*, expanded the classification by dividing the family Convolvulaceae into two subfamilies: Cuscutoideae and Convolvuloideae. Subfamily Cuscutoideae is represented by the tribe Cuscuteae, whereas subfamily Convolvuloideae comprises of two tribes; Convolvuleae (group Psiloconiae Hallier *f.*) with smooth pollen surface and Ipomoeeae (group Echinoconiae Hallier *f.*) with spinulose pollen surface. They believed that there is only a small difference in the rank and circumscription between these divisions; therefore the tribe Erycibeae proposed by Hallier (1893) were accepted as subtribes Erycibinae in their account, and then placed *Erycibe* as the only genus under this subtribe.

Within the genus *Erycibe*, Hallier (1897) subdivided this genus into two series mainly on the structure of the bark: Rimosae (longitudinal cork-ridges) and Tereticaules (lenticels) based on his observation on very few collections. However, the structure of the bark has only been accepted as supplementary character by Hoogland (1953a) and not adopted at all by Ng (1989). Bark character alone was not sufficient in distinguishing *Erycibe* species (Hoogland, 1953a).

The tribe Erycibeae was first identified as a polyphyletic group within the family which can be distinguished from other genera in the family by the absence of the style, sessile stigma and bifid corolla lobes, with dense hairs on the midpetaline bands, and a berry-like fruit (Stefanovic *et al*., 2002). Recent work on molecular phylogenetics of Convolvulaceae by Stefanovic *et al*. (2002 & 2003), has retained the genus *Erycibe* alone in the tribe Erycibeae, following Endlicher (1841).

2.3 Taxonomic studies on *Erycibe*

Erycibe is an Old World genus, centered in South East Asia and Malesia. Ridley (1923) revised Convolvulaceae in the the *Flora of the Malay Peninsula* and recorded 15 species. However, at present, some of the species were reduced to synonyms.

A few years later, Hoogland (1953a) revised the entire genus for the Malesian region covering all taxa described up to that time. He included morphological descriptions, some habitat and ecological informations. In another account, Hoogland (1953b) prepared a nomenclature review of seventy recognized species including several new taxa and provided citation of the type specimens for all the species, based on his study of the type specimens and reduced many names to synonymy. However, species descriptions were not included and not much notes on the continental Asian species were provided. He also made a mistake in using paratype for what should be syntype (George, S., *pers. comm*.).

Ng (1989) revised the family Convolvulaceae and provided an annotated key to all species of *Erycibe* in Peninsular Malaysia and Singapore. Yet, only *E. albida* was described for the *Tree Flora of Malaya*. He recognized nineteen taxa including two new taxa. However, due to incomplete materials, the new taxa were not described and named as *Erycibe* sp. A and *Erycibe* sp. B.

Fang & Staples (1995) documented ten species in *Flora of China*. The only species that also occurs in Peninsular Malaysia is *E. expansa* Wall. *ex* G. Don. This species also occurs in southern Myanmar, Peninsular Thailand and in the Nicobar Islands, India.

Staples (2010) revised ten species of *Erycibe* in *Flora of Thailand*. According to him, four from the ten species namely *E. albida*, *E. expansa*, *E. citriniflora* and *E. griffihii* have their distribution extended to Peninsular Malaysia.

2.4 Morphological studies

Morphological characters of the stem (longitudinal ridges vs. lenticels), leaves, inflorescences (terminal vs. axillary), and fruits were used by Hallier *f.* (1897) to distinguish the two taxonomic series; series Rimosae and series Tereticaules. In the series Rimosae, the young stems are densely rust-brown velvety whereas mature stems have irregular longitudinal fissures. The inflorescences are often terminal. The abaxial surfaces of the leaves are more or less conspicuously veined except in *E. helwigii* Prain (from New Guinea) and without hardened wrinkled fibres beneath. The calyx in fruit is cup-shaped and appressed. The fruit is a fleshy berry, usually ellipsoid and often flattened at the top. Hallier *f.* (1897) assigned *E. expansa*, *E. strigosa* Prain, *E. maingayi* C.B. Clarke, *E. princei* (now a synonym of *E. tomentosa* var. *tomentosa* Blume*)* and *E. malaccensis* C.B. Clarke to the series Rimosae. All these species occur in Peninsular Malaysia. In comparison, the series Tereticaules usually has terete stems and rarely rust-brown velvety hairy. The older stems are marked with pale lenticels. The inflorescences are usually axillary. The calyx in fruit is spreading and wheel-shaped. The fruit is usually rounded, woody, with pointed tip and not terminated by a flattened areole. The series Tereticaules was subdivided again into two groups: Venulosae and Fibrosae, based on the venation on the abaxial surface of the leaves. In the Venulosae, the leaves are reticulate veined beneath. In the Fibrosae, the leaves are usually glaucescent, wrinkled, hardened by sclerotic fibres and rarely scattered reticulate venation beneath. The Malaysian species in the group of Venulosae are *E. stapfiana* Prain and *E. griffithii* C.B Clarke, while the species in the group Fibrosae are *E. festiva* Prain, *E. albida* Prain, *E. rheedii* Blume, *E. aenea* Prain and *E. praecipua* Prain.

For the Malesian species, comparative morphological studies were done by Hoogland (1953a). A key for *Erycibe* species was produced based primarily on the

reproductive (floral) characters. Detailed description on the anthers and stigma were provided in the same treatment. Four different types of anther apex were observed (truncate, retuse, acute and obtuse). Hoogland (1953a) also observed the shape of the stigma apex (lobed, flat or conical) and ovary surface (glabrous, partly or completely hairy). Emphasis on floral characters has made sterile and fruiting specimens difficult to be identified. Hoogland also gave general descriptions on stem characters as longitudinal ridges and/or lenticels for each species. However, these characters are not constant for all species, mostly weakly defined and unpractical. Therefore, Hallier's concept (1897) on dividing the genus into two series based on stem characters was not followed by Hoogland (1953a) but only taken as supplementary character.

Ng (1989) basically utilized both vegetative and reproductive characters to distinguish the Malayan *Erycibe* species. Unfortunately, he only provided brief description about the plant without describing the important characters. He recognized two new taxa as *Erycibe* sp. A and *Erycibe* sp. B. *Erycibe* sp. A has velvety hairs on its inflorescences, young stem, leaf stalk and abaxial surface of leaf, with subsessile flowers, densely crowded in subglobular fascicles. Meanwhile, *E*. sp. B. has axillary, unbranched racemes and the abaxial leaf surface has sunken reticulations.

2.5 Trichome studies

Hallier (1893), has done an extensive study on the anatomical characters of the leaf in tribe Erycibeae and genus *Erycibe*. In the genus *Erycibe*, stomatal border cells are three, rarely four or five and not papillose. The leaves are sparsely hairy with 2–5-branched. The fibrovascular bundles above the sclerenchyma layer often branched out to the upper epidermis and clusters of crystals are always present. The glandular cells are present in the cotyledons.

Trichome (hair) structure from calyx and midpetaline bands had been used by Hoogland (1953a) in distinguishing *Erycibe* species. Within the genus, he found two main hair types; two-branched hairs and three-to many-branched hairs (stellate hairs). In the species with two branched hairs, a three branched hairs may be incidentally found, similarly a two branched hair may be found in some species with stellate hairs. There are few species with only two branched hairs. Simultaneously, two types of stellate hair can be observed: all branches are about the same length, or there may be one branch which is distinctly longer than the others. If the longer branched hairs are found on the midpetaline bands, there are always a rather small number of hairs with subequal branches, mainly along the lateral margin of the bands. However, Hoogland observed these through light microscope and no figures or plates were provided in his account to illustrate the character. In many cases, this character may hardly be enough to distinguish *Erycibe* species especially in the field.

2.6 Conservation status assessment

In general, *Erycibe* species are to found in forest margins, forest gaps, near the roadsides and sometimes on top of the canopy tree in dense forest, both in the protected or unprotected areas (personal observations). Although the taxonomy of *Erycibe* species has been studied and their biogeographical distributions have been recorded for the Malesian and Malayan regions (Hoogland 1953a, Hoogland 1953b; Ng, 1989), knowledge concerning their conservation status is lacking. Little information on the distribution and conservation status of *Erycibe* species in Peninsular Malaysia has led to the present study, which is essential for the management and conservation plan for threatened species. With many more recent collections after 1989, distribution study for each species is necessary.

CHAPTER 3

MORPHOLOGY

3.1 Introduction

Morphology provides most of the characters used in constructing taxonomic systems. Morphological studies based on vegetative and reproductive organs are the basis of identification and classifications of plants before plants can be sorted out into groups of known species.

Clarke (1883), Prain (1894, 1896, 1903, 1906) and Hoogland (1953a), although only referred to few specimens available at that time, had successfully utilized reproductive (flower) characters to disentangle taxonomic problems associated with the specific delimitation between *Erycibe* species. On the other hand, Ridley (1923) and Ng (1989) utilized vegetative characters, while Bacon, P.S. (*unpublished data*) developed a key based on growth habit to distinguish Sabah and Sarawak *Erycibe* species.

Many earlier botanists had successfully utilized trichome character in the species concepts. Trichome can be defined as a hairlike or bristlelike outgrowth, from the epidermis of a plant (http://www.yourdictionary.com/trichome, 13 May 2011) and trichomes have long been of considerable importance in comparative systematic investigations of angiosperms. Hoogland (1953a), is the only botanist that introduced and utilized trichome structures (hair) of the floral parts, particularly from the calyx and the midpetaline bands in *Erycibe* species. In his study on Malesian species, he observed this character through light microscopy but did not produce any figures or plates.

In the present study, both morphological and reproductive characters *Erycibe* species were examined and evaluated to provide precise descriptions and to distinguish

Erycibe at specific level. Trichomes were observed using Scanning Electron Microscopy (SEM) which allows precise measurements.

3.2 Materials and Methods

3.2.1 Herbarium studies

This study was based on the herbarium and type specimens from BKF, BM, K, KEP, KLU, L, SING and UKMB herbaria. More than 170 herbarium specimens of *Erycibe* species from Peninsular Malaysia were examined. In addition, specimens from Borneo, Singapore, Sumatra and Thailand were borrowed as a reference and to make comparison with Peninsular Malaysia species.

Data on the distribution, habitat, ecology, altitude, and morphological characters were recorded. All herbarium specimens were sorted out into groups. Almost all the Peninsular Malaysian specimens cited by Hoogland (1953) and the type specimens were observed. Thus, all new materials collected during this study were compared with those specimens cited and the type collections. New characters derived from the present study were considered and characters used in the previous study were reevaluated.

Qualitative and quantitative morphological values including vegetative and reproductive characters for each specimen were scored and compared for each taxon. The descriptions were made from herbarium specimens and the measurements given are based on dried materials except for the gynoecium and androecium. The gynoecium and androecium were rehydrated with water or taken from the spirit collections. At least three flower samples (subject to material available) were taken at random from the inflorescences. Flowers and fruits were examined under a light microscope, while calyx and midpetaline bands have also been observed under the Scanning Electron

Microscope (SEM). The materials studied (gynoecium and androecium), then were then placed in a small envelope and attached together with the herbarium specimen.

All specimens cited were examined, identified, and annotated unless otherwise stated. The terminology and definitions used mainly follow Radford *et al*. (1974) and Harris & Melinda (1994).

3.2.2 Field collections and new materials collected

A few problems were encountered during the study. First, existing herbarium specimens for some species are very few and without reproductive organs. Second, photographs of live plants and habitats of *Erycibe* species are largely lacking. Therefore, field collections were crucial in getting fresh materials as well as to obtain more information on the habitat and ecology, growth habits and species distribution. Simultaneously, during field collections, photographs of the flowers and fruits were also taken for additional reference. In addition, a few live collections from selected species were taken back for trial planting in the FRIM nursery for *ex situ* propagation (see Table 3.1).

A two year field work (2009–2010) was carried out at nine localities in Peninsular Malaysia (Table 3.1). General collections were conducted to study the common and widespread species, while specialised trips aimed to relocate the rarer species.

For new materials collected as herbarium specimens, all information observed was recorded in the FRIM collection books. The specimens were prepared following standards recommended by *The Herbarium Handbook* (Bridson & Forman, 1992). Images are attached on the herbarium specimens to indicate the important structures and colour of flowers and fruits. Herbarium specimens were deposited in KEP herbarium,

with duplicates sent to SAN, SING and K, etc., subject to number of duplicates available. New materials of flowers or fruits collected during the field study were preserved in spirit and deposited as carpological collection in KEP herbarium, Forest Research Institute of Malaysia (FRIM).

Botanical Research and Herbarium Management System (BRAHMS) version 6.0003 software was used for databasing purposes. All information from the field collections was entered into BRAHMS.

Table 3.1: Locality of samples collected and observed during field trips

Date	Locality	Target species/ Sample collections and observations
9–14 March 2009	Kedah: Pulau Tuba Air Terjun Temurun, Langkawi	 *E. rheedii* (flowers) *E. albida* (end of flowering season, collected for live collection)
5 April 2009	Terengganu: Tembat F.R., Ulu Sg. Puah	 *E. albida* (flowers)
6–9 July 2009	Perak: Bubu F.R., Gn. Bubu	 *E. albida* (unsuccessful to relocate species)
21–23 July 2009	Johor: Kluang F.R., Gn. Belumut	 *E*. sp. A (unsuccessful to relocate species)
25 December 2009 27–29 October 2010 (revisit)	Penang: Penang Hill	 *E. sapotacea* (fruiting, collected for live collection) *E. sapotacea* (no flowering season)
9 March 2010	Negeri Sembilan: Pasoh F.R.	 *E. albida* (no flowers, collected for live collection) *E. griffithii* (no flowering season) *E. tomentosa* var. *tomentosa* (no flowering season)
5 April 2010 11 June 2010 (revisit)	Perak: Korbu F.R., Kinta Dam	 *E. stapfiana* (flowers) *E. stapfiana* (end of fruiting season)
21 September 2010	Johor: Tenggaroh F.R.	 *E. aenea* (fruiting)

3.2.3 Scanning Electron Microscopy (SEM)

3.2.3.1 Observation of calyx and midpetaline bands

Trichome samples from the calyx of fifteen species and the midpetaline bands of fourteen species were taken either from spirit collections or from herbarium specimens and rehydrated in water. When only a type specimen is available, the species was not examined using SEM to prevent any damage to the type collection.

Due to the density of hairs on the calyx and midpetaline bands, these parts need extra steps in the preparation procedure to observe the trichome structure. Therefore, to see a single structure, trichome samples taken from the calyx and midpetaline bands were scattered over the labeled aluminium stub. The aluminium stub was covered by carbon conductive adhesive tape to fix the hairs. The samples were then coated with gold at 20 mA for 90 seconds in a diode sputter coater (SPI-Module). All samples were examined under a scanning electron microscope (model FEI Quantum 200). The micrographs of the trichome structure were taken at various magnifications. Measurements were taken for the shortest to the longest length of the hair branches. The terminology and definitions used mainly follow Metcalfe & Chalk (1979).

3.3 Results

3.3.1 Growth habit and twigs

The Peninsular Malaysian *Erycibe* species can be divided into several groups based on the habit i.e. consistently shrub or small tree to 6 m tall as in *E. albida*; creeper or scrambler as in *E. festiva* and the remaining species are scandent shrub or woody climber. Only *E. griffithii* was found growing to 40 m tall, which is the maximum height recorded (Table 3.2).

The twig characters especially the bark structure/surface mostly overlapped between species and is not significantly different. Therefore, it is not easy to distinguish many of the species by this character. The indumentum of young twigs varies from sparse to dense in all species. The older twigs surface become glabrescent or almost glabrous with lenticels or longitudinal ridges in several species, but the twig surface character is quite variable and not constant in each species. Therefore, twig character is impractical to use for many species. Hallier's (1897) concept which divided the genus into two series (Rimosae and Tereticaules) based on the bark structure is not entirely accepted in this study because the results show this character is not constant for most *Erycibe* species. The inner bark colour varies from pale yellow to pale brown (*E. albida* and *E. citriniflora*) to grayish (*E. maingayi*) or yellowish (*E. griffithii*) or creamy (*E. rheedii* and *E. sapotacea*).

Table 3.2. Growth habit and twig characters of *Erycibe* species.

Characters / Species	Habit	Height (m)	Stem diameter (cm)	Twigs (young)	Twigs (mature)	Inner bark (colour)
E. aenea	Scandent creeper or woody climber	4.5	5–7	Stellate hirsute	Almost glabrous with few lenticels	n.a.
E. albida	Shrub or small tree	6	3	Strigose	Glabrescent, faint longitudinal ridges and few lenticels	Pale yellow to brown
E. citriniflora	Woody climber or scandent shrub	7.6	n.a.	Densely strigose	Almost glabrous with few lenticels	Pale brown
E. expansa	Climber or scandent shrub	n.a.	n.a.	Tomentose	Brown hairy with longitudinal ridged	n.a.
E. festiva	Creeper or scrambler	20 long	7.5	Sparsely strigose	Glabrescent with few lenticels	n.a.
E. griffithii	Scandent shrub or woody climber	40	3.5	Stellate-hairy	Glabrescent, faint longitudinal ridges with few lenticels	Yellowish
E. leucoxyloides	Slender low bushy climber	n.a.	n.a.	Densely stellate-hirsute	Longitudinal ridged	n.a.
E. magnifica	Woody climber	12–15	n.a.	Densely stellate-hirsute	Glabrescent, faint with low longitudinal ridges	n.a.
E. maingayi	Climber or treelet	10	7.5	Strigose	Glabrescent with longitudinal ridges	Grayish
E. malaccensis	Woody climber	30	12	Stellate-hirsute	Glabrescent with longitudinal ridges	n.a.
E. praecipua ssp. *praecipua*	Climber or scandent shrub	n.a.	n.a.	Sparsely hairy	Longitudinal ridged	n.a.
E. rheedii	Scandent, creeper or woody climber	20	n.a.	Densely reddish to dark brown strigose-hairy	Glabrescent, smooth or rarely few orbicular lenticels	Creamy
E. sapotacea	Woody climber	15	3–4	Few lenticels or glabrous	Dark brown with conspicuous longitudinal ridges	Creamy
E. stapfiana	Slender creeper or climber	24	7	Strigose	Small orbicular lenticels	n.a.

n.a. = not available

Table 3.2. (continued).

Characters / Species	Habit	Height (m)	Stem diameter (cm)	Twigs (young)	Twigs (mature)	Inner bark
E. strigosa	Climber	18	2–5	Densely thin strigose	Longitudinally ridged	n.a.
E. tomentosa var. *hirsuta*	Probably climber	n.a.	n.a.	Densely stellate-hirsute	Longitudinally ridged	n.a.
E. tomentosa var. *tomentosa*	Climber	25	n.a.	Densely stellate-hirsute	Glabrescent with distinct longitudinal ridges	n.a.
E. sp. A	Woody climber	n.a	n.a.	Stellate-hirsute	Glabrous with few orbicular lenticels	n.a.
E. sp. B	Woody climber	n.a.	n.a.	Densely short stellate-hirsute	Almost glabrous with distinct longitudinal ridges	n.a.

n.a. = not available

3.3.2 The leaves

The leaf characters (shape, size, venation, apex and indumentum) of taxonomic importance for all *Erycibe* species treated in the present study are shown in Table 3.3 and Fig. 3.1. Leaf morphology is an important and very useful character in distinguishing the species. Leaves of *Erycibe* species are variable in shapes and sizes. They may be elliptic, oblong, elliptic-oblong, lanceolate, oblanceolate, oval-elliptic, ovate or obovate. In few cases, *E. magnifica* and *E. tomentosa* var. *tomentosa* usually have obovate laminas. The variation in leaf size also occurs within species, for example *E. albida* has a range from 12 to 40 cm long and 4.5 to 12 cm width. *Erycibe leucoxyloides* can easily be recognized by its small lamina which is less than 5.5 cm long and 2 cm width and always has inconspicuous and very few secondary veins (3 to 5 pairs). *Erycibe citriniflora*, *E. magnifica*, *E. rheedii* and *E. stapfiana* are among the species having large and wide leaves ranging between 8.5 to 31 cm long and 4.5 to 11.5 cm width. The other species have intermediate leaf sizes. The dry lamina colour may be different between species; light to dark green, dark red to brown or maroon, yellow-green, grayish or even dull or pale green. This character is usually consistent for each species and is a good character to distinguish the species especially for the dry herbarium specimens. For example, the lamina of *E. albida* is pale to dull greenish especially the abaxial surface. The lamina texture varies from thin coriaceous to thick coriaceous or chartaceous, with more species being coriaceous. Leaf base is also a useful character for distinguishing several species. For instance, *E. tomentosa* var. *hirsuta* and *E. tomentosa* var. *tomentosa* have almost cordate (rarely obtuse), *E.* sp. A usually has cordate (rarely rounded) and *E.* sp. B has almost rounded leaf base.

Table 3.3. Vegetative characters of *Erycibe* species

Species / Characters	*E. aenea*	*E. albida*	*E. citriniflora*	*E. expansa*
Leaves				
Shape	Elliptic to oblong or obovate	Oblong to oblanceolate or elliptic-oblong	Broadly elliptic to oblanceolate	Elliptic to broadly elliptic
Length (cm)	7–15	12–24(–40)	(12–)21–24(–31)	2.2–7
Width (cm)	3–4.5	4.5–8.7(–12)	(4.5–)7–11.5	1.4–4.5
Texture	Coriaceous	Thin coriaceous to coriaceous	Coriaceous	Coriaceous
Dry leaves (colour)	Reddish to brown	Pale and dull greenish especially beneath	Pale green to reddish	Reddish or dark brown
Indumentum (above)	Glabrous	Almost glabrous	Almost glabrous	Glabrous
Indumentum (beneath)	Glabrous	Almost glabrous	Short hairy	Stellate-hairy
Base	Obtuse	Cuneate	Cuneate or rarely cordate	Obtuse or sometimes cordate
Margin (dry leaf)	Flat	Revolute or rarely flat	Flat	Flat
Apex	Acuminate with obtuse tip	Acuminate	Cuspidate	Shortly acute or rarely rounded
Midrib & indumentum (above)	Sunken, glabrous	Sunken, glabrous	Sunken, glabrous	Sunken, glabrous
Midrib & indumentum (beneath)	Prominent, sparsely to densely stellate-hairy	Prominent, glabrous	Prominent, glabrous	Prominent, glabrous
Secondary veins				
Number of pairs	4(5–8)	6–10(–15)	8–11(–14)	(2–)3–4
Above	Prominent	Prominent	Sunken	Prominent
Beneath	Prominent	Prominent	Prominent	Prominent
Ending to margin	Curving and join with the next one to form a looped intramarginal vein	Sometimes close to margin	Curving close to margin	Curving close to margin; lower and middle pair usually opposite
Tertiary veins	Reticulate	Reticulate	Reticulate	Reticulate
Above	Sunken	Faint or inconspicuous	Inconspicuous	Prominent
Beneath	Sunken	Faint or inconspicuous	Prominent	Prominent
Petioles	Terete	Angular	Almost terete	Terete
Length (mm)	(5–)7–13	11–15(–20)	8–12	2–5
Thickness (mm)	1–2	1–2(–6)	1.3(–2)	1–2
Indumentum	Densely stellate-hirsute	Glabrous	Densely hairy, soon glabrescent	Hairy to densely hairy
Channelled adaxially at base	Yes	Yes	Yes	No

n.a. = not available

Table 3.3. (continued).

Species / Characters	*E. festiva*	*E. griffithii*	*E. leucoxyloides*	*E. magnifica*
Leaves				
Shape	Elliptic-oblong	Elliptic-oblong to ovate-oblong	Elliptic to oval-elliptic	Elliptic to obovate
Length (cm)	7–14	(7.5–)8.5–14.5	1.1–5.5	8.5–18
Width (cm)	3–7	(2.8–)4.1–8	0.5–2	5.2–8.7
Texture	Coriaceous	Coriaceous	Chartaceous	Thickly coriaceous
Dry leaves (colour)	Dull brown	Dark brown or brown reddish	Reddish brown	Green and glossy above, light brown beneath
Indumentum (above)	Glabrous	Almost glabrous	Glabrous with tiny black dots	Almost glabrous
Indumentum (beneath)	Glabrous	Almost glabrous	Glabrous with tiny black dots	Densely stellate-villose
Base	Cuneate	Cuneate to obtuse	Obtuse	Obtuse
Margin (dry leaf)	Flat	Flat	Flat	Strongly revolute
Apex	Acuminate	Acuminate	Acute to obtuse tip	Obtuse
Midrib & indumentum (above)	Sunken, glabrous	Sunken, glabrous	Sunken, glabrous	Sunken, densely stellate-villose
Midrib & indumentum (beneath)	Prominent, glabrous	Prominent, glabrous	Prominent, glabrous	Prominent, densely stellate-villose
Secondary veins				
Number of pairs	6–9	5–8	3–5	(6–)10–13
Above	Inconspicuous	Prominent	Inconspicuous, rarely conspicuous	Sunken
Beneath	Prominent, faint conspicuous	Prominent	Inconspicuous, rarely conspicuous	Prominent
Ending to margin	Slightly curving close to margin	Close to margin	Usually inconspicuous	Close to margin
Tertiary veins	Reticulate	Closely transverse order	Inconspicuous	Reticulate
Above	Inconspicuous	Prominent	Inconspicuous	Inconspicuous
Beneath	Faintly prominent	Prominent	Inconspicuous	Conspicuous
Petioles	Terete, slender	Terete	Terete, slender	Terete
Length (mm)	8–10	8–12	1–2	10–15
Thickness (mm)	1–2	*c.* 1	1–2	4–7
Indumentum	Sparsely stellate-hirsute or glabrous	Glabrous	Densely stellate-hirsute	Densely strigose (simple hair)
Channelled above at base	Yes	No	No	No

n.a. = not available

Table 3.3. (continued).

Species / Characters	*E. maingayi*	*E. malaccensis*	*E. praecipua* ssp. *praecipua*	*E. rheedii*
Leaves				
Shape	Elliptic-oblong	Ovate or elliptic to oblong	Elliptic-oblong	Elliptic oblong to oblong
Length (cm)	6–15	(4.5–)5–9(–11)	5.3–10.5	3.5–22(–24)
Width (cm)	4.5–5.5	(1.5–)2.3–3.6(–4.1)	2.3–4.1	5–9(–11)
Texture	Thinly coriaceous to coriaceous	Coriaceous	Thickly coriaceous	Coriaceous
Dry leaves (colour)	Dark brown or maroon	Always pale brown/yellowish	Glossy yellowish brown	Dull or dark brown
Indumentum (above)	Glabrous	Almost glabrous	Glabrous	Glabrous
Indumentum (beneath)	Glabrous	Almost glabrous	Glabrous	Glabrous
Base	Cuneate	Obtuse	Obtuse	Obtuse to cuneate
Margin (dry leaf)	Flat	Flat	Flat	Flat
Apex	Shortly acuminate or acute	Acuminate-obtuse	Acuminate	Shortly acuminate to acuminate or obtuse
Midrib & indumentum (above)	Sunken, glabrous	Prominent, glabrous	Prominent, rarely sunken, glabrous	Faintly sunken, glabrous
Midrib & indumentum (beneath)	Prominent, glabrous	Prominent, glabrous	Prominent, glabrous	Faintly prominent, sparsely stellate-hirsute
Secondary veins				
Number of pairs	4–9	4–8 with lower pair sometimes opposite	3–5	(5–)8–11
Above	Faint prominent	Faint prominent	Faint prominent	Prominent
Beneath	Faint prominent	Faint prominent	Prominent	Prominent
Ending to margin	Close to margin	Curving and join with the next one to form a looped intramarginal vein	Close to margin	Curving close to margin
Tertiary veins	Reticulate	Reticulate	Reticulate	Reticulate
Above	Prominent	Prominent	Sunken or sometimes inconspicuous	Prominent
Beneath	Prominent	Prominent	Sunken or sometimes inconspicuous	Prominent
Petioles	Terete	Terete, slender	Terete	Terete
Length (mm)	8–15	4(–6)	5–10	5–8
Thickness (mm)	1–1.2	1–1.5	1–1.5	1–2
Indumentum	Glabrous	Densely stellate-hirsute	Glabrous	Glabrous
Channelled adaxially at base	No	No	Yes	Yes

n.a. = not available

Table 3.3. (continued).

Species / Characters	*E. sapotacea*	*E. stapfiana*	*E. strigosa*	*E. tomentosa* var. *hirsuta*
Leaves				
Shape	Elliptic-oblong	Elliptic oblong to oblong	Elliptic-oblong	Elliptic-oblong or ovate
Length (cm)	11.2–19.6	8.5–17(–20)	7–12	4–9
Width (cm)	4.8–8.8	3–7(–8.5)	3.5–6.5	1.5–4
Texture	Thickly coriaceous	Chartaceous	Coriaceous	Coriaceous
Dry leaves (colour)	Glossy greenish above, dull green beneath	Glossy green	Dull or pale brown	Dull green
Indumentum (above)	Glabrous	Glabrous	Glabrous	Almost glabrous
Indumentum (beneath)	Glabrous	Glabrous	Densely black and strigose but soon glabrescent	Densely long stellate-hirsute
Base	Obtuse to cuneate	Cuneate	Acute or obtuse	Almost cordate
Margin (dry leaf)	Flat	Flat	Flat	Flat
Apex	Shortly acuminate, rarely acute	Acuminate	Long acuminate with obtuse tip	Acuminate
Midrib & indumentum (above)	Almost sunken, glabrous	Prominent, glabrous	Sunken, glabrous	Sunken, sparsely stellate-hirsute
Midrib & indumentum (beneath)	Prominent, glabrous	Prominent, glabrous	Prominent, strigose hairy	Prominent, densely stellate-hirsute
Secondary veins				
number of pairs	5–8	5–7	6–7	4–6
Above	Prominent	Prominent	Sunken	Prominent
Beneath	Prominent	Prominent	Prominent	Prominent
Ending to margin	Close to margin	Close to margin	Looping close to margin	Curving close to margin
Tertiary veins	Reticulate	Closely transverse order	Reticulate	Reticulate
Above	Prominent	Prominent	Inconspicuous	Inconspicuous
Beneath	Prominent	Strongly prominent	Prominent	Prominent
Petioles	Terete, slender	Almost terete	Angular	Terete
Length (mm)	10–15	7–10	12–20	1–2
Thickness (mm)	8–12(–16)	1–2	1–2	*c.* 1
Indumentum	Glabrous	Sparsely stellate-hairy to glabrous	Densely strigose (simple hairs) or 2-branched hairs	Densely stellate-hirsute
Channelled adaxially at base	Yes	Yes	No	No

n.a. = not available

Table 3.3. (continued).

Species / Characters	*E. tomentosa* var. *tomentosa*	*E.* sp. A	*E.* sp. B
Leaves			
Shape	Obovate or ovate-oblong	Elliptic to oblong	Oval-elliptic to oblong
Length (cm)	4.5–11.5	5–14	9.8–16
Width (cm)	2–7	2–6	5.7–8.5
Texture	Coriaceous	Thickly coriaceous	Thickly coriaceous
Dry leaves (colour)	Pale to dark green	Brown to dark brown	Brownish
Indumentum (above)	Glabrous	Glabrous	Glabrous
Indumentum (beneath)	Almost glabrous	Densely stellate-hirsute	Densely stellate-hirsute
Base	Almost cordate or rarely obtuse	Cordate, rarely obtuse	Almost rounded
Margin (dry leaf)	Flat	Flat	Flat
Apex	Obtuse or acuminate to broad acute	Short acuminate, rarely acute	Cuspidate with blunt tip
Midrib & indumentum (above)	Sunken, glabrous	Sunken, glabrous	Sunken, glabrous
Midrib & indumentum (beneath)	Prominent, almost glabrous	Prominent, densely stellate-hirsute beneath	Prominent, hairy
Secondary veins			
Number of pair	5–8	5–8	4–6
Above	Prominent	Almost sunken	Faintly conspicuous
Beneath	Prominent	Prominent	Prominent
Ending to margin	Ending close to margin or clearly looping	Curving about 45°, close to margin	Curving close to margin
Tertiary veins	Reticulate	Closely transverse order	Reticulate
Above	Prominent	Conspicuous	Inconspicuous
Beneath	Prominent	Conspicuous	Sunken
Petioles	Terete	Angular	Terete
Length (mm)	2–4	7–14	7–14
Thickness (mm)	1–1.1	2–3	2–3
Indumentum	Densely stellate-hirsute	Densely stellate-hirsute but soon glabrescent	Densely stellate-hirsute but soon glabrescent
Channelled above at base	No	No	No

n.a. = not available

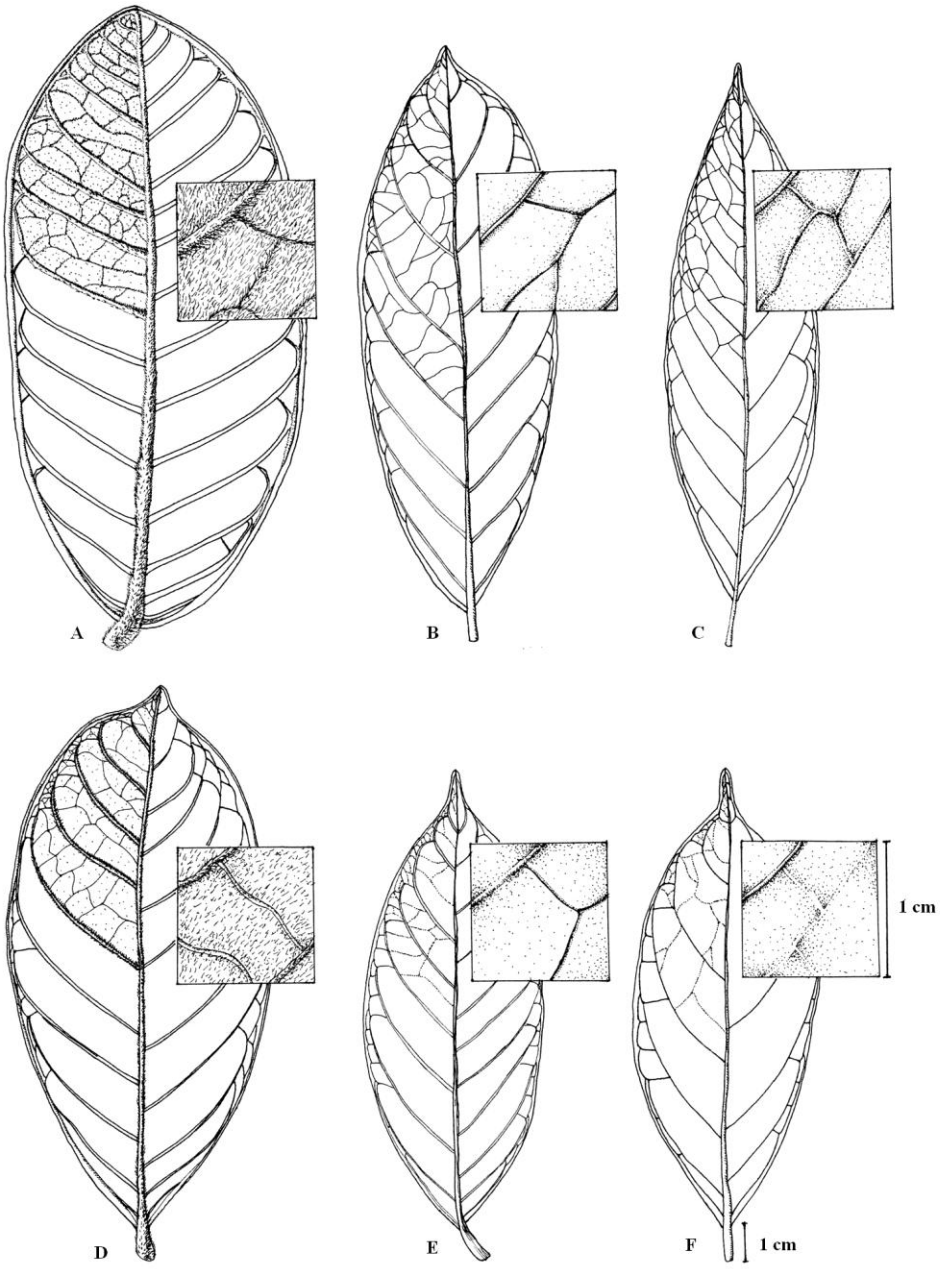

Fig. 3.1. Leaf characters (shape, size, venation, apex and indumentum) of *Erycibe* species. A, *E. magnifica* (*3879*); B, *E. rheedii* (*KEP137697*); C, *E. albida* (*FRI58096*); D, *E. citriniflora* (*SFN34317*); E, *E. festiva* (*SK513*); F, *E. maingayi* (*21332*).

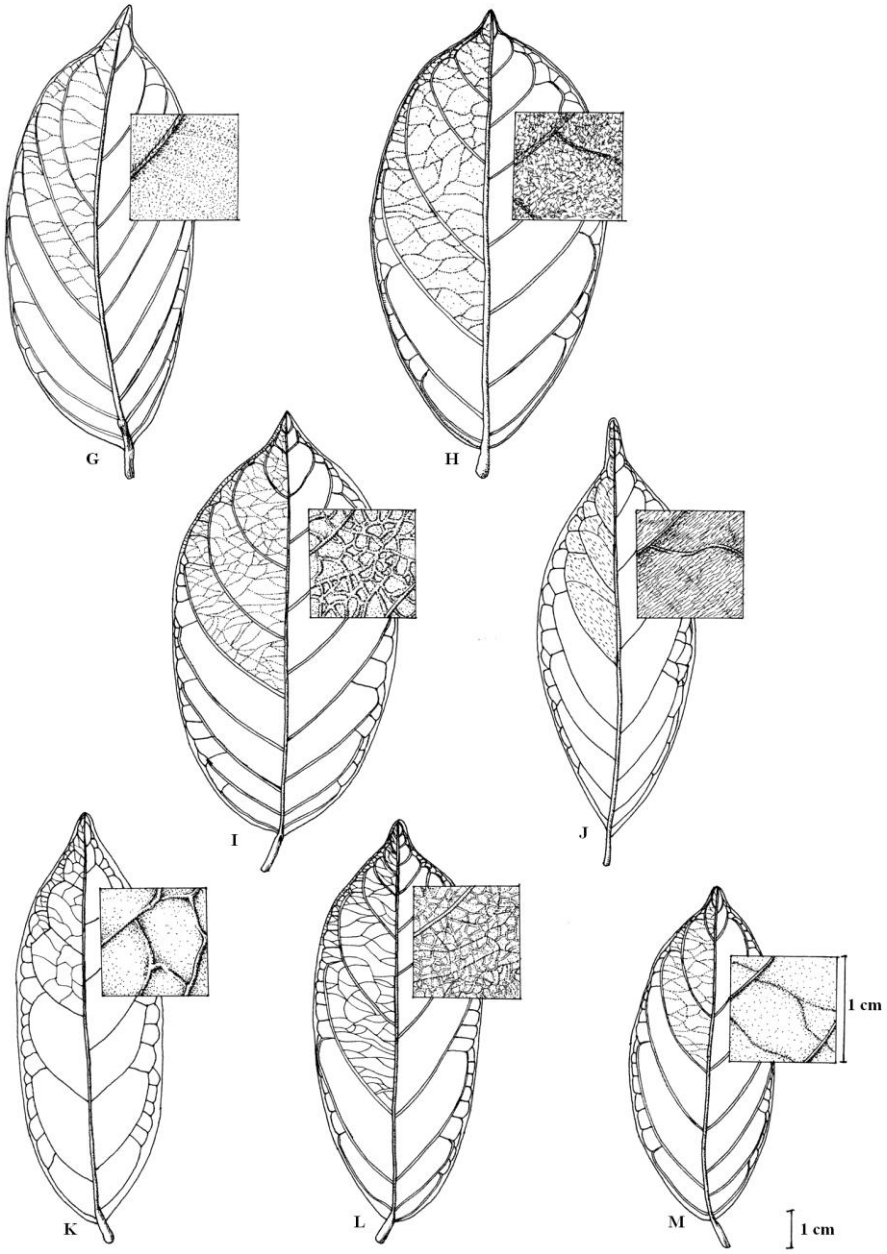

Fig. 3.1. (continued). G, *E*. Sp. A. (*FRI8850*); H, *E*. Sp. B (*EG2015*); I, *E. sapotacea* (*FRI29329*); J, *E. strigosa* (*8461*); K, *E. aenea* (*7337*); L, *E. stapfiana* (*FRI2647*); M, *E. griffithii* (*8191*).

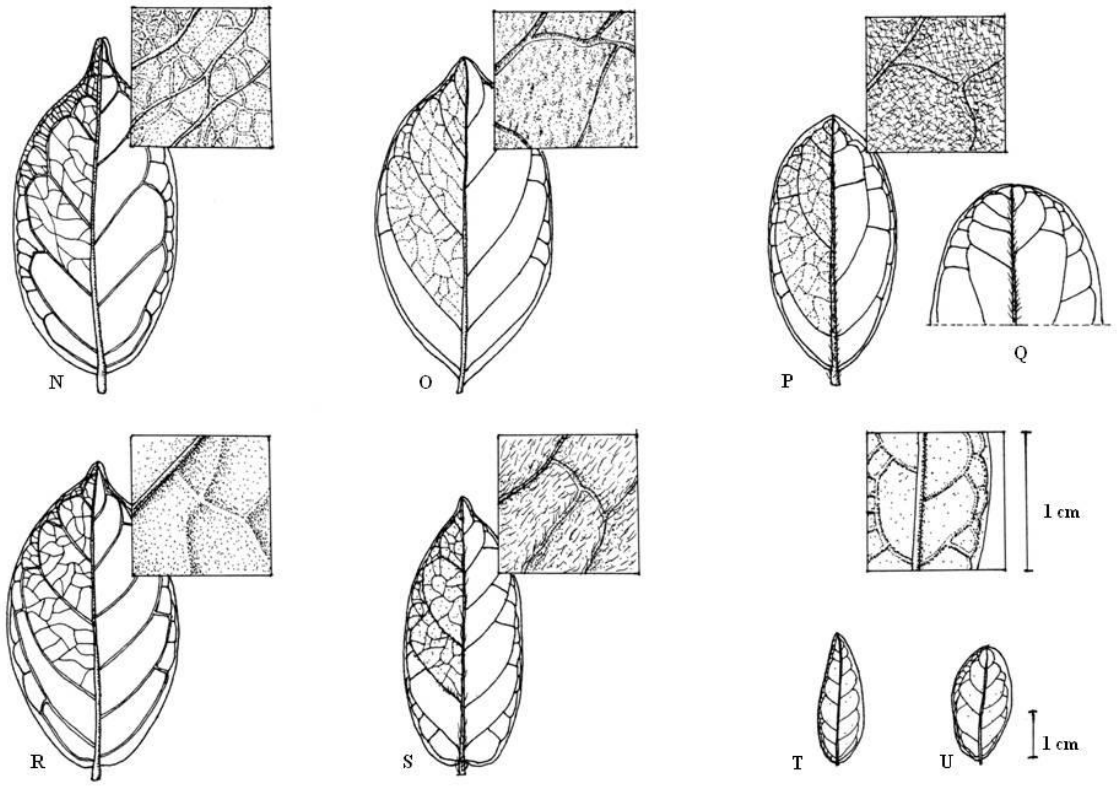

Fig. 3.1. (continued). N, *E. malaccensis* (*EG1703*); O, *E. praecipua* ssp. *praecipua* (*28441*); P, *E. expansa*- acute apex, Q- rounded apex (*2128*); R, *E. tomentosa* var. *tomentosa* (*Anonymous, s.n.*); S, *E. tomentosa* var. *hirsuta* (*SFN32367*); T, *E. leucoxyloides*- acute apex (*1172*); U, *E. leucoxyloides*- obtuse aex (*2408*).

The leaf margin is always flat when dry in most species studied except in *E. albida* and *E. magnifica*, where the leaf margin is always revolute. The leaf apex is either acute, acuminate, cuspidate or obtuse. *Erycibe strigosa* is different from other species by its long acuminate apex (1.3 to 1.5 cm long) while *E. magnifica* is easily recognized by its obtuse apex and *E. expansa* sometimes has obtuse apex (but usually has very short acute apex).

The abaxial surface of the leaf varies from densely to sparsely hairy or glabrous. The abaxial surface of *E. citriniflora, E. expansa, E. magnifica, E. strigosa, E. tomentosa* var. *tomentosa, E.* sp. A and *E.* sp. B are hairy, while other species are glabrous or almost glabrous. The abaxial surface of the leaf is covered with dense hairs in *E. magnifica, E. strigosa*, *E. tomentosa* var. *hirsuta*, *E.* sp. A and *E.* sp. B. For adaxial leaf surface, almost all species are glabrous or almost glabrous. *Erycibe leucoxyloides* possesses tiny black dots on both adaxial and abaxial leaf surfaces.

In general, the secondary veins in *Erycibe* species are alternately arranged. The tertiary veins also provide a good supplementary character for recognizing few species. Most of the species possess reticulate venation. However, *E. griffithii, E. stapfiana* and *E.* sp. A. have closely transverse order venation.

The petioles of *Erycibe* species are either terete and slender, almost terete or angular. Only *E. albida*, *E. strigosa* and *E.* sp. A have conspicuous angular petioles. Majority of the species studied have hairy indumentum on petioles except for *E. albida*, *E. griffithii*, *E. maingayi*, *E. praecipua* ssp. *praecipua*, *E. rheedii* and *E. sapotacea*. In addition to this, *E. albida, E. festiva* and *E. praecipua* ssp. *praecipua*, *E. sapotacea*, and *E. stapfiana* have channelled petiole bases.

3.3.3 The inflorescences

The important taxonomic characters of the inflorescences for all Peninsular Malaysian *Erycibe* species are tabulated in Table 3.4. A few species (*E. aenea*, *E. rheedii*, *E. stapfiana*, *E. tomentosa* var. *hirsuta*, *E. tomentosa* var. *tomentosa* and *E.* sp. A) have both terminal and axillary inflorescences. Other species have axillary inflorescence. *Erycibe expansa* has only terminal inflorescence. There are species possessing solitary flowers (exclusively solitary in *E. leucoxyloides*; and sometimes in *E. albida* and *E. griffithii*). The inflorescence type is also a useful character in distinguishing species. Three main types of inflorescence were observed in *Erycibe* species which are glomerules, racemose, and paniculate. *Erycibe citriniflora* and *E.* sp. A possess glomerules; *E. tomentosa* var. *tomentosa* and *E. tomentosa* var. *hirsuta* possess paniculate-racemose inflorescences; other species possesses either racemose or paniculate inflorescences. *Erycibe strigosa* has the longest inflorescence, up to 26 cm long.

The length of pedicels mostly overlaps between species (1 to 4 mm long). However, *E. griffithii* has the longest pedicels (5 to 6 mm long) and *E.* sp. A, has the shortest pedicels not more than 1 mm long or pedicels absent.

The bracteoles in *Erycibe* species varies from linear to oval in shape. *Erycibe strigosa* and *E.* sp. B have conspicuous bracteoles (up to 5 mm long). The bracteoles are hairy both on adaxial and abaxial surfaces.

Table 3.4. Inflorescence position, type, length, pedicel length and indumentum and bracteoles characters in *Erycibe* species.

Characters / Species	Inflorescences			Pedicels		Bracteoles				
	Position	Type	Length (cm)	Length (mm)	Indumentum	Shape	Length (mm)	Width (mm)	Indumentum (adaxial surface)	Indumentum (abaxial surface)
E. aenea	Terminal and axillary	Racemose	1–4	1–2	Densely stellate-hirsute	Linear	1.5–2	*c*. 0.5	Sparsely stellate-hirsute	Sparsely stellate-hirsute
E. albida	Axillary	Solitary or glomerules	To 1.2	1–3	Strigose but soon glabrescent	Ovate	*c*. 1	*c*. 1	Sparsely stellate-hairy	Sparsely stellate-hairy
E. citriniflora	Axillary	Dense glomerules	5–8	1–3	Densely stellate-hairy	Linear	2.5–4	*c*. 1	Densely stellate-hairy	Densely stellate-hairy
E. expansa	Terminal	Paniculate	(12–)15–21	1–3	Densely stellate-hairy	Linear	1–2	0.5–1	Sparsely stellate-hairy	Sparsely stellate-hairy
E. festiva	Axillary	Racemose	1.5	1.5–4	Densely stellate-hirsute	Lanceolate	*c*. 2	*c*. 0.5	Densely hirsute	Densely stellate-hirsute
E. griffithii	Axillary	Solitary/Racemose (2–4 together)	1.2	5–6	Strigose	Linear	1–1.5	0.5–1	Densely stellate-hairy	Densely stellate-hairy
E. leucoxyloides	Axillary	Solitary	n.a	3–4	Densely stellate-hairy	Elliptic	2–2.5	1–1.5	Densely stellate-hairy	Sparsely stellate-hairy
E. magnifica	Axillary	Racemose	To 4.5	4–5	Stellate-hirsute	Elliptic	*c*. 1.2	*c*. 1	Densely stellate-hirsute	Densely stellate-hirsute
E. maingayi	Axillary	Racemose	To 2	1–5	Densely stellate-hairy	Linear to ovate	1–1.2	0.7–1.2	Densely stellate-hairy	Densely stellate-hairy
E. malaccensis	Axillary	Racemose	To 9	4–6	Stellate hirsute	Elliptic-oval	4–5	1.5–2	Densely stellate-hirsute	Densely stellate-hirsute
E. praecipua ssp. *praecipua*	Axillary	Racemose	To 1.8	2–5	Sparsely strigose	Linear	*c*. 1	*c*. 0.5	Sparsely stellate-hairy	Sparsely stellate-hairy
E. rheedii	Terminal and axillary	Paniculate	To 15	1–3	Densely stellate-hairy	Ovate to oblong	1.5–2	*c*. 0.5	Densely stellate-hairy	Densely stellate-hairy
E. sapotacea	Axillary	Racemose	To 1.2	1–2	Densely stellate-hairy	Elliptic	*c*. 1.5	*c*. 0.5	Densely stellate-hairy	Sparsely stellate-hairy
E. stapfiana	Terminal and axillary	Paniculate	To 0.65	2–4	Densely stellate-hairy	Elliptic	0.8–1.2	*c*. 1	Densely stellate-hairy	Sparsely to densely stellate-hairy
E. strigosa	Axillary	Paniculate	To 26	1–2	Densely strigose	Elliptic	*c*. 5	*c*. 2	Densely strigose	Densely strigose

Table 3.4. (continued).

Characters / Species	Inflorescences			Pedicels		Bracteoles				
	Position	Type	Length (cm)	Length (mm)	Indumentum	Shape	Length (mm)	Width (mm)	Indumentum (adaxial surface)	Indumentum (abaxial surface)
E. tomentosa var. *hirsuta*	Terminal and axillary	Leafy paniculate or racemose	To 3.5	1–2	Densely stellate-hirsute	Linear	1–1.5	0.5–1	Densely stellate-hirsute	Densely stellate-hirsute
E. tomentosa var. *tomentosa*	Terminal and axillary to leaves	Leafy paniculate or racemose	To 9	1.5–3	Densely stellate-hirsute	Ovate	2–3	*c*. 1	Densely stellate-hirsute	Densely stellate-hirsute
E. sp. A	Terminal and axillary	Glomerules	0.6–1.2	None or *c*. 1	Densely stellate-hirsute	Linear or elliptic	2–3	*c*. 0.5	Densely stellate-hirsute	Densely stellate-hirsute
E. sp. B	Axillary	Racemose	n.a	n.a	n.a	Elliptic or obovate	3.5–5	2–2.2	Densely stellate-hirsute	Densely stellate-hirsute

3.3.4 The calyx

Calyx surfaces were also observed in *Erycibe* species. The morphological characters of calyx in *Erycibe* species are shown in Table 3.5. Hoogland (1953a), used structures of the hairs (from calyx and midpetaline bands) for taxonomic distinction in *Erycibe* species.

In general, the two outer sepals are usually different in shape from three inner ones. However, all five sepals are almost the same in shape in *E. expansa* (elliptic) and *E. praecipua* ssp. *praecipua* (broadly ovate or orbicular to transverse-oval).

The calyx surfaces for all species are hairy outside and glabrous inside except for *E. albida*. *Erycibe albida* is the only species with glabrous sepals on the outer surface. In *E. leucoxyloides*, the calyx outer surface is always almost glabrous near the margin. In the present study, hair types can be categorized into 3 main groups; a= 2-branched, b= stellate (3-to many-branched hairs) and c= dendritic (trichomes branched along an extended axis).

Erycibe festiva (Fig. 3.2E), *E. maingayi* (Fig. 3.2H), *E. praecipua* ssp. *praecipua* (Fig. 3.3J), *E. sapotacea* and *E. strigosa* have exclusively 2-branched hairs, while in *E. griffithii* (Fig. 3.2F) and *E. tomentosa* var *tomentosa*, 2-branched hairs and stellate hairs may be found together. Only *E. stapfiana* has stellate and dendritic hair type on calyx surface (Fig. 3.3L). Other species have stellate hairs on the calyx.

In species having stellate hairs, the hairs can be subequal or unequal-branched. In unequal-branched species, one branch of the hairs is conspicuously longer than other branches. This character can be found in *E. citriniflora* (Fig. 3.2C), *E. leucoxyloides* (Fig. 3.2G), *E. magnifica*, *E. rheedii* (Fig. 3.3K), *E. tomentosa* var. *hirsuta* and *E*. sp. A (Fig.

3.3M). Also, within the taxon, the hairs may be grouped as stalked or sessile hairs. However, most of the hair length overlaps between species.

Table 3.5. Calyx morphology in *Erycibe* species.

Characters / Species	Calyx						Hair branches (outside surface)					Stalked (ST)/ Sessile (SS)
	Two outer sepals			Three inner sepals			Number	Length (μm)	Equality	1-branch conspicuously longer	Group	
	Shape	Length (mm)	Width (mm)	Shape	Length (mm)	Width (mm)						
E. aenea	Orbicular to transverse oval	2–2.3	2–2.8	Transverse-oval	2–2.5	3–3.5	7–8	To 530	Subequal	No	b	ST
E. albida	Orbicular	2–2.5	2–2.5	Transverse-oval	2.3–2.8	2.5–3	–	–	–	–	Glabrous	–
E. citriniflora	Orbicular	*c.* 3	*c.* 3	Transverse-oval	2–2.5	2.5–3	4–5	To 360	Unequal	Yes	b	ST
E. expansa	Elliptic	1.5–2	1.2–1.5	Elliptic	1.5–2	1.2–1.5	3–5	To 340	Subequal	No	b	ST
E. festiva	Orbicular	2–2.5	2–2.5	Transverse-oval	2–2.5	*c.* 3	2	To 160	Subequal	No	a	SS
E. griffithii	Broad-ovate or triangular-ovate	1.8–2	*c.* 2	Transverse-oval	2.5–2.7	3–3.5	2–3	To 310	Subequal	No	a & b	ST
E. leucoxyloides	Orbicular	2–2.5	2–2.5	Transverse-oval	2–2.3	2.5–3	4–7	To 380	Unequal	Yes	b (almost glabrous near margin)	ST
E. magnifica	Orbicular	*c.* 5	*c.* 5	Transverse-oval	*c.* 5	*c.* 6	2–6	To 1500	Unequal	Yes	b	n. a.
E. maingayi	Orbicular	2.5–3	2.5–3	Transverse-oval	2.3–2.8	2.5–3	2	To 300	Subequal	No	a	ST
E. malaccensis	Orbicular to transverse oval	3.3–4	3.3–5	Transverse-oval	2.5–3	3–4	(3–)4–8	To 350	Subequal	No	b	SS

a= 2-branched; b= stellate; c= dendritic; n.a. = not available (could not be sampled because only type specimen available); *c*. = about.

Table 3.5. (continued).

Characters / Species	Calyx						Hair branches					Stalked (ST)/ Sessile (SS)
	Two outer sepals			Three inner sepals			Number	Length (μm)	Equality	1-branch conspicuously longer	Group	
	Shape	Length (mm)	Width (mm)	Shape	Length (mm)	Width (mm)						
E. praecipua ssp. *praecipua*	Broadly ovate or orbicular to transverse-oval	1.8–2	1.8–2.5	Broadly ovate or orbicular to transverse-oval	1.8–2	1.8–2.5	2	To 200	Subequal	No	a	SS
E. rheedii	Broadly ovate to orbicular or transverse oval	2.5–3	2.5–3	Transverse-oval	2–2.5	2.8–3.2	5–6	To 380	Unequal	Yes	b	ST
E. sapotacea	Broadly ovate	c. 2.7	c. 3	Transverse-oval	c. 2.5	c. 3.2	2	To 400	n.a.	n.a.	a	n. a.
E. stapfiana	Orbicular	3–3.5	3–3.5	Orbicular to transverse-oval	1.9–2.2	1.9–2.5	5–8	To 130	Subequal	No	b & c	ST
E. strigosa	Oval	c. 2.5	c. 2	Transverse-oval	c. 2	c. 2.5	2	To 500	n.a.	n.a.	a	n. a.
E. tomentosa var. *hirsuta*	Orbicular to transverse oval	3–4	3–5	Transverse oval	3.5–4	4–5	3	To 750	Unequal	Yes	b	n. a.
E. tomentosa var. *tomentosa*	Orbicular to transverse oval	3–4	3–5	Transverse oval	3.5–4	4–5	2–5	To 500	Subequal	No	a & b	SS
E. sp. A	Orbicular to transverse oval	c. 2 ×	2–3	Ovate	2.5–3	2–2.5	4–6	To 600	Unequal	Yes	b	ST
E. sp. B	Orbicular	3.5–4.5	3.5–4.5	Ovate	c. 3	c. 2.5	4–5 or more	To 180	Subequal	No	b	ST

a= 2-branched; b= stellate; c= dendritic; n.a. = not available (could not be sampled because only type specimen available); *c*. = about.

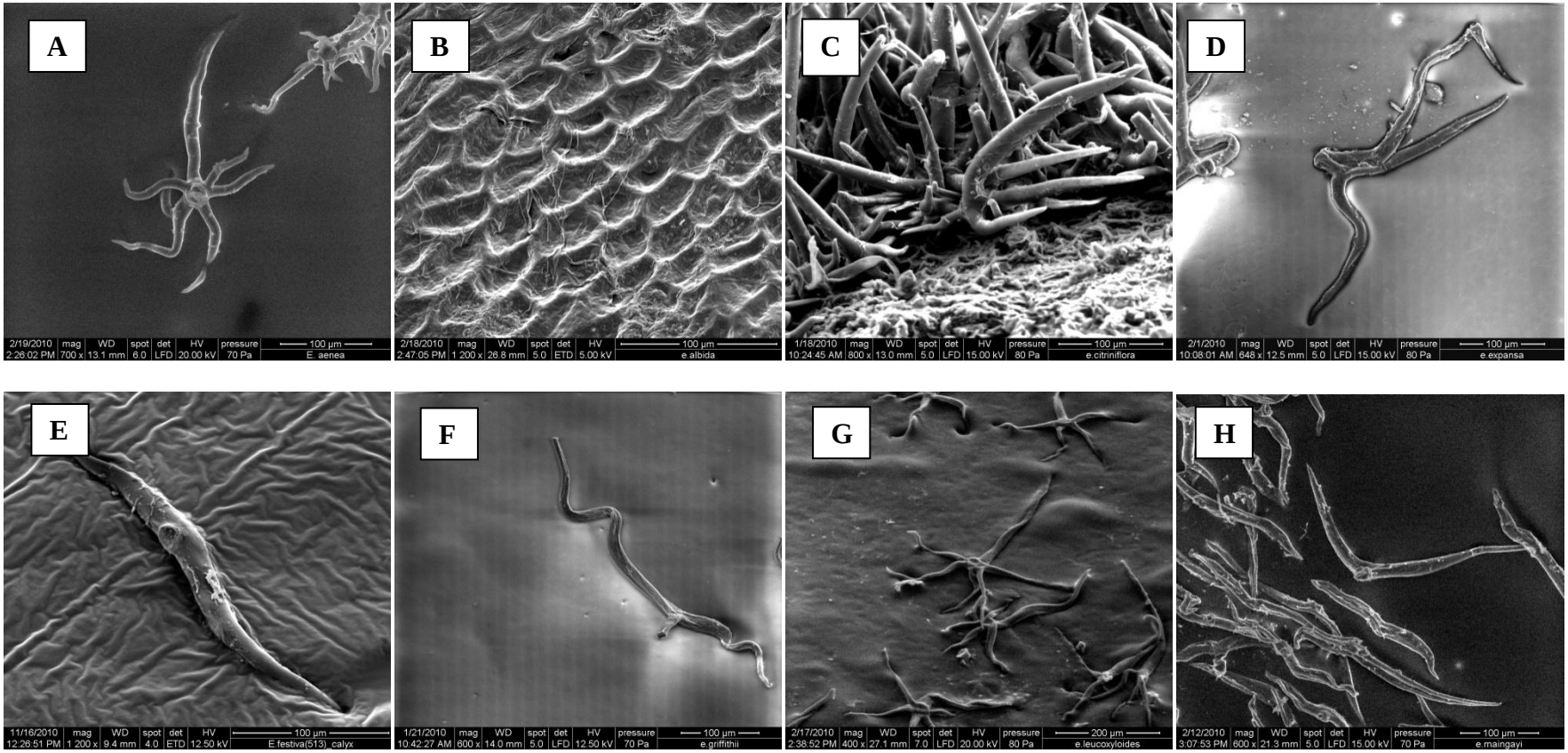

Fig. 3.2. Micrographs of calyx surfaces in eight *Erycibe* species. A, *E. aenea*; B, *E. albida*; C, *E. citriniflora*; D, *E. expansa*; E, *E. festiva*; F, *E. griffithii*; G, *E. leucoxyloides*; H, *E. maingayi.*

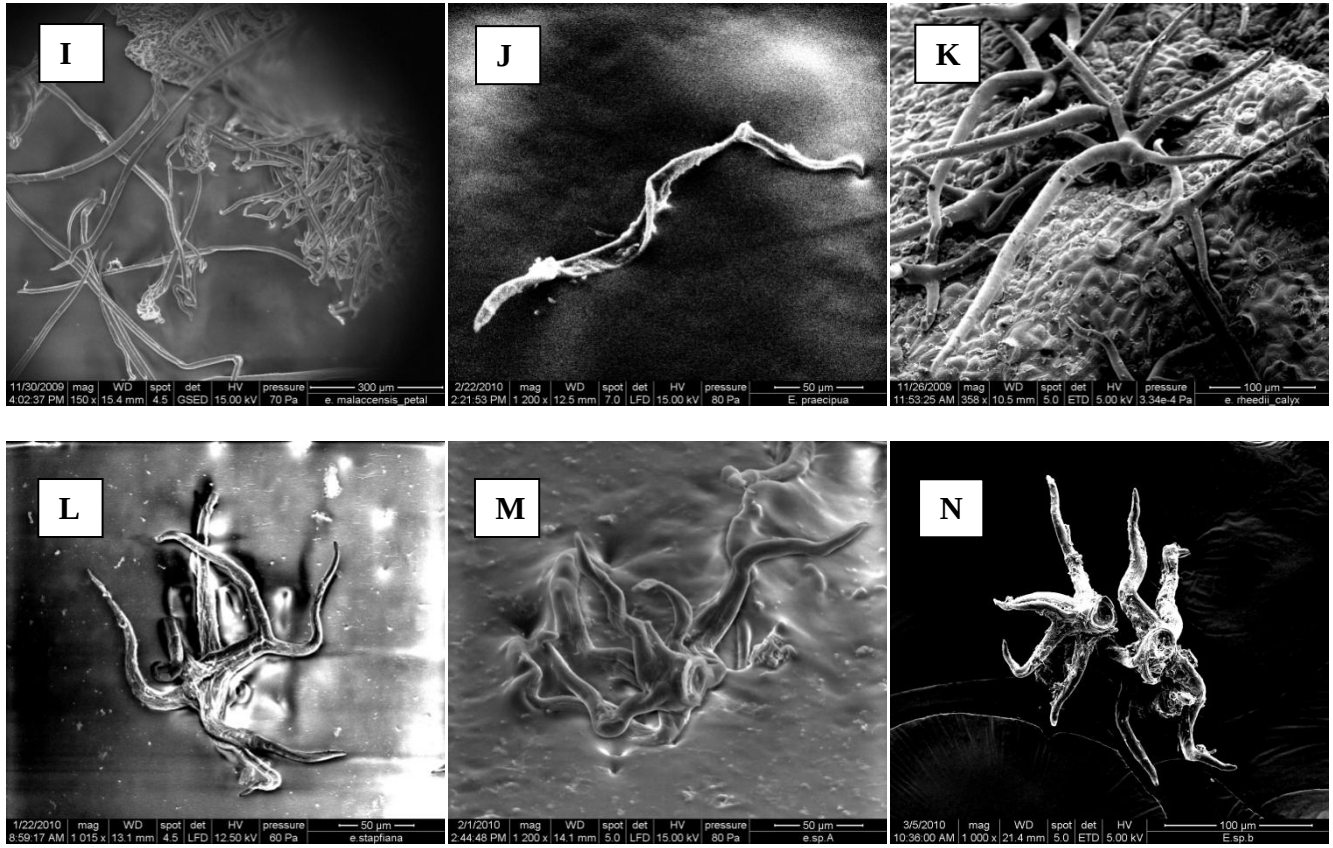

Fig. 3.3. Micrographs of calyx surfaces in six *Erycibe* species. I, *E. malaccensis*; J, *E.praecipua* ssp. *praecipua*; K, *E. rheedii*; L, *E. stapfiana*; M, *E.* sp. A; N, *E.* sp. B.

3.3.5 The corolla

Table 3.6 shows the corolla morphology of *Erycibe* species. Corolla of *Erycibe* is not showy and the colour varies from white to waxy white, tinged pink, cream, and yellowish to dark yellow and occasionally brownish grey. However, in determining the species, the colour of corolla cannot be used as an independent character. The length of corolla ranges from 5 to 20 mm long and 5 to 18 mm diameter. The length of tube mostly overlaps between species and ranges from 0.5 to 4 mm long. *E. praecipua* ssp. *praecipua* is distinct from other species because the corolla is hairy on the outer as well as inner surface. As shown in Table 3.6, *E. albida* and *E. citriniflora* are among the species with large corolla size.

Table 3.6. Corolla morphology in *Erycibe* species

Characters / Species	Colour	Length (mm)	Diameter (mm)	Tube length (mm)	Indumentum (outer surface)	Indumentum (inner surface)
E. aenea	Light yellow to yellow	7–8.5	9–10	2–2.5	Stellate-hairy	Glabrous
E. albida	White or waxy white	11–13	14–16	1.5–2	Stellate-hairy	Glabrous
E. citriniflora	Yellowish	10–20	*c.* 10	1.5–2	Stellate-hairy	Glabrous
E. expansa	White or tinged pink	*c.* 8	*c.* 10	1.3–1.7	Stellate-hairy	Glabrous
E. festiva	Pale greenish white	*c.* 5	*c.* 8	*c.* 1	Stellate-hairy	Glabrous
E. griffithii	White	6–7	5–6	1.5–2.5	Stellate-hairy	Glabrous
E. leucoxyloides	White	*c.* 6	*c.* 5	*c.* 3	Stellate-hairy	Glabrous
E. magnifica	Dark yellow	*c.* 10	n.a.	*c.* 4	Stellate-hairy	Glabrous
E. maingayi	Cream	8–9	5–6	2.5–3	Stellate-hairy	Glabrous
E. malaccensis	White	7–11	*c.* 10	2–4	Stellate-hairy	Glabrous
E. praecipua ssp. *praecipua*	Yellowish	*c.* 7	*c.* 8	1.7–2	Stellate-hairy	Stellate-hairy
E. rheedii	White, cream, light yellow	7–9	8–9	2.5–3	Stellate-hairy	Glabrous
E. sapotacea	n.a.	*c.* 7.5	n.a	*c.* 2.5	Stellate-hairy	Glabrous
E. stapfiana	Waxy white or cream	9–11	16–18	2–2.5	Stellate-hairy	Glabrous
E. strigosa	Brownish grey	n.a.	n.a.	n.a.	n.a.	n.a.
E. tomentosa var. *hirsuta*	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
E. tomentosa var. *tomentosa*	White	8–10	5–6	*c.* 0.5	Stellate-hairy	Glabrous
E. sp. *A*	Lemon yellow	*c.* 5	*c.* 8	*c.* 0.5	Stellate-hairy	Glabrous
E. sp. *B*	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.

n.a. = not available; *c.* = about

3.3.6 The midpetaline bands

The morphological differences of midpetaline bands in *Erycibe* species are shown in Table 3.7. The size of midpetaline bands ranges from 2 to 7.5 mm long and 0.5 to 3.5 mm width. The longest midpetaline bands occur in *E. albida* (5 to 7.5 mm long) and *E. leucoxyloides* (4 to 6 mm long).

The outer surface of the midpetaline bands for all species are densely hairy. From the specimens studied, the hair structure of midpetaline bands can be useful to distinguish several species. In the present study, hair types are categorized into 3 main groups; a= 2-branched, b= stellate and c= dendritic. The dendritic trichomes branch along an extended axis. *Erycibe festiva* and *E. strigosa* have exclusively 2-branched hairs. Other species possesses 3- to many-branched hairs (stellate hairs). However, in stellate hairy species, a few 2-branched hairs may be found, for example in *E. maingayi* (Fig. 3.4H) and *E. praecipua* ssp. *praecipua* (Fig. 3.5J). The dendritic hair structure can be found in *E. albida* (Fig. 3.4B) and *E. stapfiana* (Fig. 3.5L).

In *E. aenea*, there is a difference in hair structure between the lower and upper part of the midpetaline bands. The hair structure is subequal on lower part and unequal (a single branch is conspicuously longer than others) on the upper part of the midpetaline bands.

The hairs also can be found sessile, stalked or both sessile/stalked. Most of the species have stalked hairs except for *E. citriniflora* (Fig. 3.4C), *E. malaccensis* (Fig. 3.5I), *E. praecipua* ssp. *praecipua* (Fig. 3.5J) and *E. tomentosa* var. *tomentosa* (Fig. 3.5M). While in *E. aenea* and *E. albida* hairs are found sessile and also stalked.

Table 3.7. Midpetaline bands morphology in *Erycibe* species.

Characters / Species	Midpetaline bands size (mm)	Indumentum						
		Hair branch						Stalked (ST)/ Sessile (SS)
		Number of branched	Length (μm)	Lower part	Upper part	1-branched longer	Group	
E. aenea	3–4 × 2–2.4	5–7	250–530	Subequal	Unequal	Yes	b	ST & SS
E. albida	5–7.5 × 0.5–1.5	3–4	180–708	Unequal, dendritic	Unequal, dendritic	No	b	ST & SS
E. citriniflora	3.5–4 × 3	4–6	325–484	Unequal	Unequal	Yes	b	SS
E. expansa	3.5–4 × 1.5–1.8	4–5	122–491	Subequal	Subequal	No	b	ST
E. festiva	*c*. 5 × 3	2	163–405	Unequal	Unequal	Yes	a	ST
E. griffithii	4.5–5 × 3–3.5	3–5	140–440	Subequal	Subequal	No	b	ST
E. leucoxyloides	4–6 × 2–2.3	3–5	472–943	Unequal	Unequal	Yes	b	ST
E. magnifica	n.a.	1–4	200	n.a.	n.a.	Yes	b	n.a.
E. maingayi	2.7–3.5 × 1.7–2	2–4	257–685	Unequal	Unequal	No	a & b	ST
E. malaccensis	3–3.5 × 2–2.5	2–7	to 750	Unequal	Unequal	Yes	b	Almost SS
E. praecipua ssp. *praecipua*	3.5–3.8 × 1.6–2.2	2–4	131–223	Subequal	Subequal	No	a & b	Almost SS
E. rheedii	3–4 × 1.8–2.8	4–6	to 180	Subequal	Subequal	No	b	ST
E. sapotacea	*c*. 3.5 × 2	2–5	500	n.a.	n.a.	n.a.	n.a.	n.a.
E. stapfiana	4–5 × 3–3.5	7–8	132–284	Subequal, unequal & dendritic	Subequal, unequal & dendritic	Yes	b	ST
E. strigosa	n.a.	2	800	n.a.	n.a.	n.a.	a	n.a.
E. tomentosa var. *hirsuta*	n.a.	n.a.	2000	n.a.	n.a.	n.a.	n.a.	n.a.
E. tomentosa var. *tomentosa*	2–3 × 1.2–2	3–4	to 680	Unequal	Unequal	Yes	b	Almost SS
E. sp. *A*	2–2.5 × 1–1.5	3–5	to 720	Unequal	Unequal	Yes	b	ST
E. sp. *B*	*c*. 2 × 1.5	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.

a= 2-branched; b= stellate; c= dendritic; n.a. = not available (could not be sampled because only type specimen available); *c*. = about.

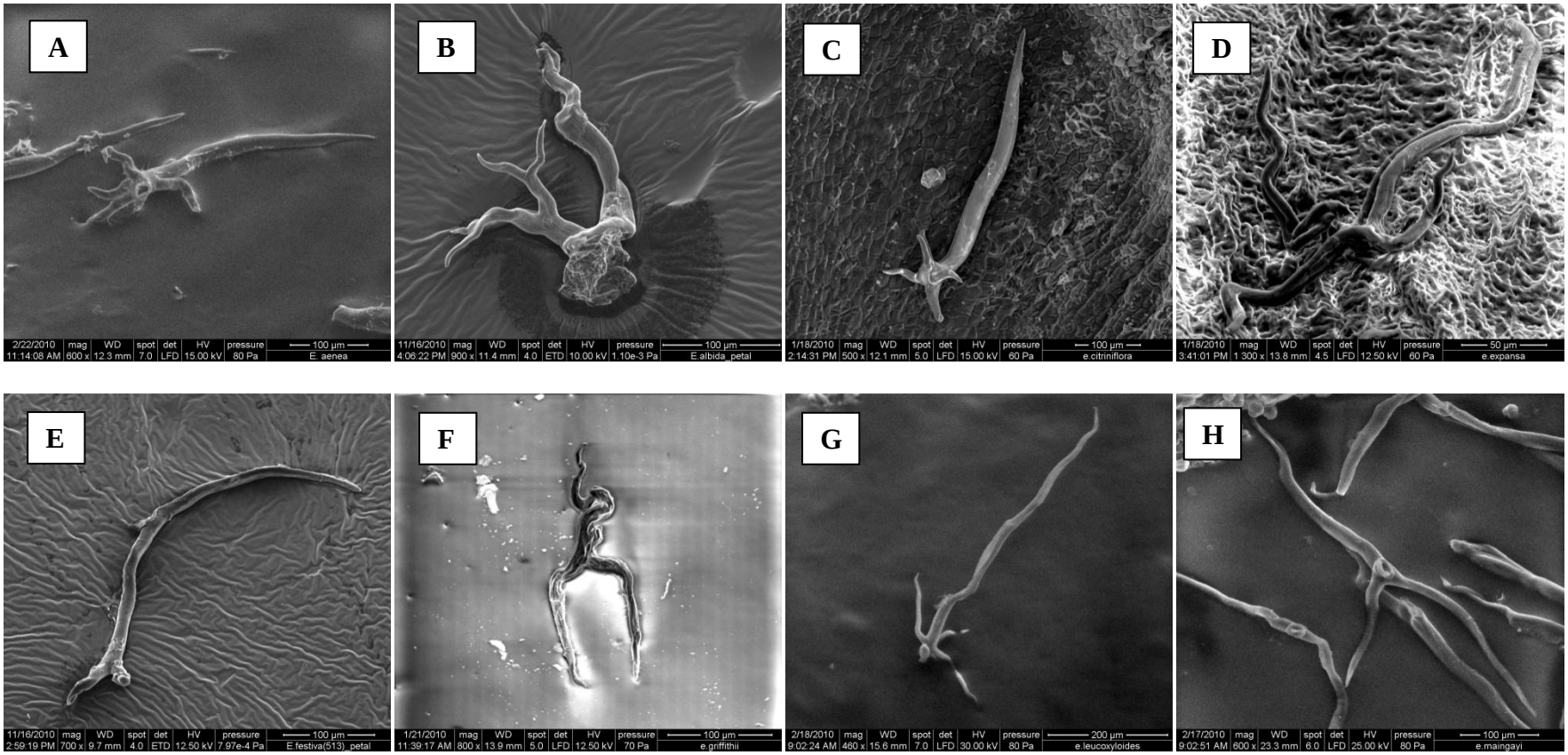

Fig. 3.4. Micrographs of midpetaline bands trichomes in eight *Erycibe* species. A, *E. aenea*; B, *E. albida*; C, *E. citriniflora*; D, *E. expansa*; E, *E. festiva*; F, *E. griffithii*; G, *E. leucoxyloides*; H, *E. maingayi.*

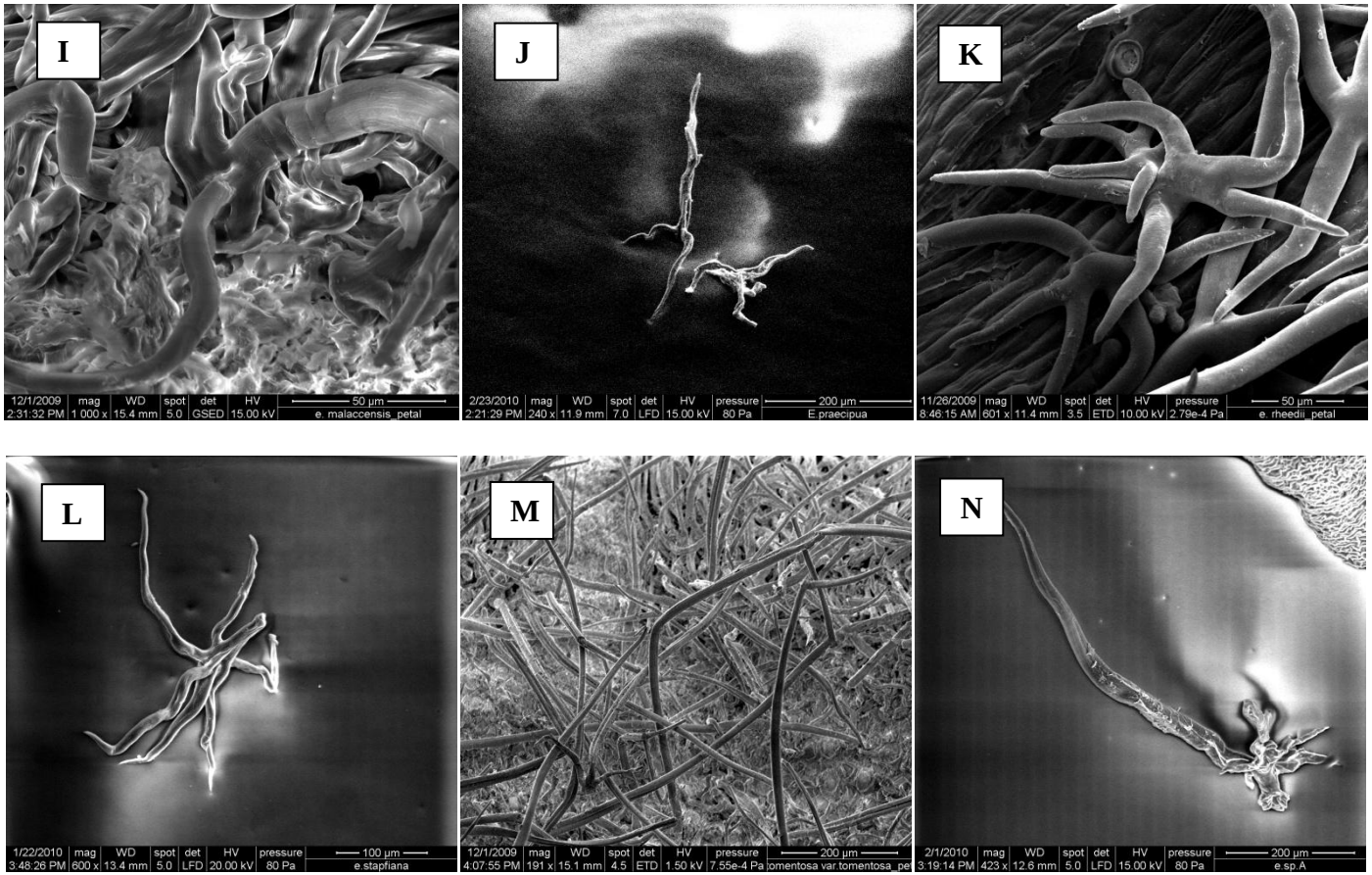

Fig. 3.5. Micrographs of midpetaline bands trichomes in six *Erycibe* species. I, *E. malaccensis*; J, *E.praecipua* ssp. *praecipua*; K, *E. rheedii*; L, *E. stapfiana*; M, *E. tomentosa* var. *tomentosa*; N, *E.* sp. A.

3.3.7 The corolla lobes and lobules

Among the species studied, the longest and widest lobes and lobules are found in *E. albida* and *E. stapfiana*. In general, *Erycibe* has oblong lobules, except in *E. magnifica,* which has a distinctive lobule shape: clavate (club-shaped). Lobule margins are entire in *E. citriniflora, E. leucoxyloides, E. maingayi, E. malaccensis, E. praecipua* ssp. *praecipua, E. rheedii* and *E.* sp. A. Only *E. tomentosa* var. *tomentosa* has consistently toothed lobule margins, while other species posseses entire or sometimes minutely toothed lobule margins. This character is not consistent in several species and considered not a valuable character to distinguish the species.

Although there are differences between inconspicuous and conspicuous longitudinal venation on the lobules, this character is best observed and can be clearly seen in the fresh corolla and not from the herbarium specimens.

Table 3.8. Corolla lobes and lobule morphology and morphometrics in *Erycibe* species.

Characters / Species	Lobes			Lobules				
	Length (mm)	**Width (mm)**	**Position above the midpetaline bands (mm)**	**Shape**	**Length (mm)**	**Width (mm)**	**Margin**	**Longitudinal venation**
E. aenea	*c.* 5	*c.* 4	1.5	Oblong	3–5	*c.* 2	Minutely toothed	Conspicuous
E. albida	8–9	5–6	1.5	Oblong	4–9	2–6	Entire or minutely toothed	Conspicuous
E. citriniflora	3–4	2–3	*c.* 3	Oblong	1.5–2	1.5	Entire	Inconspicuous
E. expansa	4–6	4–5	*c.* 2	Oblong	3–3.5	*c.* 2	Entire or minutely toothed	Inconspicous
E. festiva	5–6	*c.* 2	*c.* 1	Oblong	3.5–4.5	3–3.5	Minutely toothed	Inconspicous
E. griffithii	4–5	2–2.5	*c.* 2.5	Oblong	2–2.8	2–2.5	Entire or minutely toothed	Inconspicous
E. leucoxyloides	*c.* 4	*c.* 5	just above	Oblong	3.5	2.5	Entire	Conspicuous
E. magnifica	n.a.	n.a.	n.a.	*Clavate	**c.* 2.5	**c.* 2	n.a.	n.a.
E. maingayi	4–4.5	3–3.5	*c.* 2	Oblong	1–1.5	2–2.5	Entire	Inconspicuous or faintly conspicuous
E. malaccensis	3.5–4.5	4–6	*c.* 1.5	Oblong	2.5–4.5	3.5–5.5	Entire	Conspicuous
E. praecipua ssp. *praecipua*	*c.* 4	*c.* 2.5	*c.* 1.5	Oblong	*c.* 1.8	*c.* 1.5	Entire	Faintly conspicuous
E. rheedii	5–6	7.5–8.5	*c.* 5	Oblong	5–6	2.5–3.3	Entire	Inconspicuous
E. sapotacea	*c.* 5	*c.* 2	just above	Oblong	*c.* 2.5	*c.* 2	Entire or toothed	Inconspicuous
E. stapfiana	9–11	9–10	*c.* 0.5	Oblong	8–9	3.5–4.5	Entire or minutely toothed	Conspicuous
E. strigosa	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
E. tomentosa var. *hirsuta*	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
E. tomentosa var. *tomentosa*	4–5	2–3	1–1.5	Oblong	3–3.5	1.5–1.8	Toothed	Inconspicuous
E. sp. A	*c.* 2.5	*c.* 1.5	*c.* 0.5	Oblong	*c.* 2	*c.* 1	Entire	Inconspicuous
E. sp. B	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.

n.a. = not available; *c.* = about; *source from Hoogland (1953a).

3.3.8 The androecium

The stamens of *Erycibe* species are attached near the corolla base. As shown in Table 3.9, the absent of filament is found only in *E. griffithii* which is a good character to distinguish the species, while for all species, filament lengths ranges between 0.5 to 2.5 mm long. Filaments are broader at the base, except for *E. rheedii*, which has slender filaments. The length of anther ranges from 0.5 to1.8 mm long and the width from 0.4 to 1 mm. The anther length and width shows no significant difference between species.

The anther base and apex are also good supplementary characters in distinguishing the species. The anther bases vary from cordate, subcordate, to broadly cordate and the anther apices vary from acute, through acuminate, retuse, truncate to obtuse. In a few species studied, both the anther base and apex are important characters to distinguish the species; for example, *E. griffithii* possesses retuse base and apex; *E. praecipua* ssp. *praecipua* and *E. sapotacea* possess truncate base and apex; and *E. magnifica* possesses subcordate base and obtuse apex.

Table 3.9. Androecium morphology and morphometrics in *Erycibe* species

Characters / Species	Stamen				
	Filament length (mm)	**Anther length (mm)**	**Anther thickness (mm)**	**Anther base**	**Anther apex**
E. aenea	1.2–1.5	0.5–0.8	0.6–0.8	Subcordate	Acuminate
E. albida	0.5–2.5	1–1.5	0.5–0.7	Broadly cordate	Acute
E. citriniflora	1–1.5	1–1.5	0.5–0.7	Broadly cordate	Acute to acuminate
E. expansa	1.3–1.5	1.3–1.5	*c.* 1	Subcordate	Long acuminate
E. festiva	0.5–1	*c.* 1.8	0.5–0.6	Broadly cordate	Acute
E. griffithii	Absent	0.4–0.5	0.7–0.8	Retuse	Retuse
E. leucoxyloides	*c.* 0.7	*c.* 1.2	*c.* 0.5	Subcordate	Acuminate
E. magnifica	*c.* 0.5	*c.* 0.8	*c.* 0.8	Subcordate	Obtuse
E. maingayi	0.6–0.9	1.1–1.3	0.5–0.7	Cordate	Acuminate
E. malaccensis	0.8–1.5	1.3–1.7	0.4–0.8	Broadly cordate	Acuminate
E. praecipua ssp. *praecipua*	0.2–0.4	*c.* 0.7	0.4–0.5	Truncate	Truncate
E. rheedii	2–2.5	*c.* 1.5	0.7–1	Cordate	Acuminate
E. sapotacea	*c.* 1.3	*c.* 0.7	*c.* 0.5	Truncate	Truncate
E. stapfiana	1.8–2	0.6–0.8	*c.* 1	Cordate	Acuminate
E. strigosa	n.a.	n.a.	n.a.	*Cordate	*Acuminate
E. tomentosa var. *hirsuta*	n.a.	n.a.	n.a.	n.a.	n.a.
E. tomentosa var. *tomentosa*	1–1.3	0.8–0.9	*c.* 1	Subcordate	Acuminate
E. sp. *A*	*c.* 0.5	*c.* 1	*c.* 1	Subcordate	Acute
E. sp. *B*	**c.* 0.5	**c.* 0.7	**c.* 0.7	n.a.	n.a.

n.a. = not available; *c.* = about; *source from Hoogland (1953a).

3.3.9 The gynoecium

The ovary of all *Erycibe* species is ellipsoid and can be grouped into glabrous, partly hairy, or completely hairy. In a few species (*E. aenea*, *E. festiva*, *E. rheedii*, *E. stapfiana*, *E*. sp. A and *E*. sp. B), the ovaries are glabrous or sometimes partly hairy either on the upper or lower part. *Erycibe magnifica* differs from other species in being densely hirsute over the whole ovary surface. Other species have glabrous surface, except *E. citriniflora* which sometimes has glabrous or densely hirsute ovary.

As shown in Table 3.10, all species have a conical stigma. However, species differ in the number of ridges (5- or 10-ridged) at the stigma apex. This character is useful and can be a supplementary character to distinguish *Erycibe* species.

Table 3.10. Gynoecium morphology and morphometrics in *Erycibe* species

Characters / Species	Ovary			Stigma	
	Length (mm)	**Width (mm)**	**Indumentum**	**Shape**	**Apex (ridges)**
E. aenea	*c.* 1	1–1.3	Glabrous or glabrous at lower part, sparsely hirsute at apex	Conical	10-ridged
E. albida	1.7–2.1	0.8–0.9	Glabrous	Conical	5 faint to distinct ridges
E. citriniflora	1.7–2.1	0.8–0.9	Glabrous or densely hirsute	Conical	10-ridged
E. expansa	*c.* 0.8	*c.* 1	Glabrous	Conical	5-ridged
E. festiva	1–1.5	1.3–1.7	Appressed-hairy at upper part only	Conical	10 faint to distinct ridges
E. griffithii	1.5–2	1–1.5	Glabrous	Conical	10-ridged
E. leucoxyloides	*c.* 0.9	*c.* 0.7	Glabrous	Conical	5-ridged
E. magnifica	*c.* 1	*c.* 1.5	Densely hirsute whole surface	Conical	5-ridged
E. maingayi	0.7–1.1	0.8–1.1	Glabrous	Conical	5-ridged
E. malaccensis	0.7–1.5	1.2–1.7	Glabrous	Conical	5-ridged
E. praecipua ssp. *praecipua*	1–1.2	0.9–1.2	Glabrous	Conical	5–10-ridged
E. rheedii	1.3–1.5	1–1.2	Glabrous or glabrous at lower part, stellate-hirsute at upper part	Conical	10-ridged
E. sapotacea	*c.* 2.8	*c.* 1.7	Glabrous	Conical	5 faint ridges
E. stapfiana	0.7–1.2	0.8–1.3	Glabrous or glabrous at lower part, densely short stellate-hirsute at upper part	Conical	5-ridged
E. strigosa	n.a.	n.a	*Glabrous	*Conical	n.a.
E. tomentosa var. *hirsuta*	n.a.	n.a.	n.a.	n.a.	n.a.
E. tomentosa var. *tomentosa*	1–1.2	1	Glabrous	Conical	5-ridged
E. sp. *A*	*c.* 0.5	*c.* 0.5	Glabrous or sparsely hairy at lower part, glabrous at upper part	Conical	10-ridged
E. sp. *B*	*c.* 0.5	*c.* 0.5	Glabrous or glabrous at lower part, sparsely stellate-hairy at upper part	Conical	5-ridged

n.a. = not available; *c.* = about; *source from Hoogland (1953a).

3.3.10 The infructescences and fruits

The length of pedicels in *Erycibe* species ranges from 0.6 to 15 mm long (Table 3.11). The longest and thickest pedicels are found in *Erycibe magnifica* (9 to 10 mm long and 3 to 5 mm thick) and *E. sapotacea* (10 to15 mm long and 3.3 to 3.5 mm thick). The glabrous pedicel can be found only in *E. albida*, *E. praecipua* ssp. *praecipua* and *E. sapotacea*. The other species have either sparsely to densely hairy pedicels.No fruiting specimens were available for *E. expansa*, *E. festiva*, *E. strigosa*, *E. tomentosa* var. *hirsuta* and *E.* sp. A.

The fruit of *Erycibe* species is berry-like with a single seed. Typically, *Erycibe* has ellipsoid or ovoid fruit shape (Table 3.12). The fruit shape is rarely obpyriform (*E. stapfiana*) and globular (*E.* sp. B.). The fruit size is a good character to distinguish a few species for instance, *E. magnifica* and *E. sapotacea* possesses large fruit (2.9 to 4.8 cm long and 2.3 to 3.4 cm diameter). The other species have small to intermediate fruit size. Fruit base and apex varies from acute and tapered to obtuse.

The indumentum of fruit surfaces is also a reliable character for distinguishing species. The fruit surface is either glabrous (in most species), or scurfy (*E. aenea* and *E. griffithii*), or wrinkled-fissured (*E. sapotacea*) or densely hairy (*E. magnifica* and *E. stapfiana*). The fruit indumentum of *E. magnifica* is densely long stellate-hairy whereas *E. stapfiana* is densely short stellate-hairy.

In *Erycibe* species, the exocarp is either scarcely fleshy or coriaceous. The mesocarp is either fleshy (*E. albida*, *E. griffithii*, *E. maingayi*, *E. malaccensis* and *E. praecipua* ssp. *praecipua*) or coriaceous (*E. sapotacea*). Immature fruits vary in colour

from greenish to grayish brown or greenish to light yellow, bluish green or light brown, while ripe fruits mostly orange or reddish-orange to dark purple.

Cotyledons in the species studied are flat as found in *E. aenea, E. albida, E. citriniflora, E. leucoxyloides, E. magnifica, E. maingayi, E. malaccensis, E. rheedii, E. stapfiana* and *E. tomentosa* var. *tomentosa*) or folded as observed in *E. griffithii*, *E. praecipua* ssp. *praecipua* and *E. sapotacea*. This character is also a reliable character in distinguishing *Erycibe* species if the fruit is available.

Table 3.11. Pedicel character in *Erycibe* species.

Characters / **Species**	**Pedicel**		
	Length (mm)	**Thick (mm)**	**Indumentum**
E. aenea	1–2(–4)	1–2	Densely stellate-hirsute
E. albida	4–5	1	Glabrous
E. citriniflora	2.3–4.5	1	Shortly stellate-hairy
E. expansa	n.a.	n.a.	n.a.
E. festiva	n.a.	n.a.	n.a.
E. griffithii	0.6–1.6	1	Sparsely stellate- hairy
E. leucoxyloides	3–4	1	Densely stellate-hirsute
E. magnifica	9–10	3–5	Densely stellate-hirsute
E. maingayi	3–4	1	Sparsely strigose (simple hairs)
E. malaccensis	2–4	1–2	Densely short stellate-hirsute
E. praecipua ssp. praecipua	1–1.7	1	Glabrous
E. rheedii	5–8	1	Densely stellate-hairy
E. sapotacea	10–15	3.3–3.5	Glabrous
E. stapfiana	4–10	1	Densely short stellate-hairy
E. strigosa	n.a.	n.a.	n.a.
E. tomentosa var. *hirsuta*	n.a.	n.a.	n.a.
E. tomentosa var. *tomentosa*	3–5	1	Stellate-hirsute
E. sp. A	n.a.	n.a.	n.a.
E. sp. B	4–10	1.5–2	Densely stellate-hirsute

n.a. = not available

Table 3.12. Infructescence morphology in *Erycibe* species.

Characters / Species	Fruit									
	Shape	**Length (cm)**	**Diameter (cm)**	**Base**	**Apex**	**Exocarp**	**Immature colour**	**Ripening colour**	**Mesocarp**	**Seed (Cotyledon)**
E. aenea	Ovoid or ellipsoid	1.2–2.5	1–1.9	Obtuse	Obtuse	Scarcely fleshy, thick, scurfy	Greenish to grayish brown	n.a.	n.a.	Flat
E. albida	Ellipsoid	1.5–2.5	0.5–1	Tapered	Tapered	Probably scarcely fleshy, smooth, glabrous	Green to light yellow	n.a.	Fleshy	Flat
E. citriniflora	Ellipsoid	2.5–3.3	2–2.4	Obtuse	Obtuse	Coriaceous, glabrous or sparsely short stellate-hairy	n.a.	Purple	n.a.	Flat
E. expansa	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
E. festiva	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
E. griffithii	Ellipsoid or ovoid	1.5–3.5	1–1.7	Tapering-obtuse	Tapering-obtuse	Probably scarcely fleshy, thick, scurfy	Grayish brown when dry	Orange	Fleshy	Folded
E. leucoxyloides	Ellipsoid	0.7–0.9	0.4–0.6	Acute	Obtuse	Glabrous, smooth	Green	n.a	n.a	Flat
E. magnifica	Flattened-ellipsoid	2.9	2.3	Obtuse	Obtuse	Densely long strigose-hairy	n.a.	n.a.	n.a.	Flat
E. maingayi	Ellipsoid	1–2	0.6–0.7	Obtuse	Obtuse	Coriaceous, glabrous, smooth	n.a.	n.a.	Fleshy	Flat
E. malaccensis	Ellipsoid	0.9–1.5	0.5–1.3	Obtuse	Obtuse	Coriaceous, glabrous, smooth	Bluish-green	Reddish-orange	Fleshy	Flat
E. praecipua ssp. praecipua	Ellipsoid	1–1.8	0.8–1.2	Tapered	Tapered	Coriaceous, glabrous, smooth	n.a.	Dull orange	Fleshy	Strongly folded

n.a. = not available

Table 3.12. (continued)

Characters / Species	Fruit									
	Shape	**Length (cm)**	**Diameter (cm)**	**Base**	**Apex**	**Exocarp & surface**	**Immature colour**	**Ripening colour**	**Mesocarp**	**Seed (Cotyledon)**
E. rheedii	Ellipsoid	1.9–2.1	1–1.2	Obtuse	Shortly acute	Probably scarcely fleshy, glabrous or rather stellate-hairy near apex	Light green	Brownish to black	n.a.	Flat
E. sapotacea	Ovoid	1.8–4.8	1.3–3.4	Obtuse or sometimes tapered	Acutish or sometimes tapered	Scarcely fleshy or coriaceous, wrinkled, fissured when dry with small white lenticels	Pale green to light brown	n.a.	Coriaceous, orangish	Strongly folded
E. stapfiana	Obpyriform or sometimes ellipsoid	(0.8–)1.5–2.2(–3.6)	(0.8–)1–1.3(–2.7)	Obtuse	Tapered	Coriaceous or scarcely fleshy, densely short brown stellate-hairy	n.a.	n.a.	n.a.	Flat
E. strigosa	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
E. tomentosa var. *hirsuta*	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
E. tomentosa var. *tomentosa*	Ellipsoid to ovoid	1–1.2	0.6–0.8	Obtuse	Acute	Thin, glabrous, smooth	Green to orange-reddish	Blackish	n.a	Flat
E. sp. A	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
E. sp. B	Ellipsoid or globular	1.8–2.1	1.5–1.8	Obtuse	Obtuse	Thick, glabrous	Green to orange	Blackish	n.a.	n.a.

n.a. = not available

3.4 Discussion

For identification of Peninsular Malaysia *Erycibe* species, characters such as twig surface, inner bark texture and colour are not considered good taxonomic characters. Thus, these characters can only be supplementary evidences for field identification at least at the generic level. Whitmore (1972) reported that bark surface changes with the size of the tree, and in particular, the bark of small individuals is usually smooth. However, in *Erycibe* species, the surface of young twigs (usually small tree or climber) are always hairy, while the older twigs become glabrescent with lenticels or longitudinal ridges.

The morphological characters of the leaves of *Erycibe* species are variable and often overlapping between species. A combination of leaf characters such as shape, size, texture, colour of dry leaves, type of indumentum, base, margin, apex, midrib, secondary and tertiary veins, petiole channelled length and thickness can provide useful characters in identifying species.

Similarly, in reproductive characters, good characters to identify species include inflorescence type, length, pedicel length, indumentum of the pedicel, indumentum of the calyx, indumentum of the midpetaline bands, lobule shape, anther base and anther apex, indumentum of the ovary, and stigma apex. Other characters such as lobule margin, lobule venation, ovary length and width, stigma shape are not very useful in distinguishing *Erycibe* species.

Even though Hoogland (1953a) used the indumentum characters in his key to the identification of taxa, in the present study it is proven that the indumentum of calyx and midpetaline band can be employed only as supplementary characters in identifying *Erycibe* species. The hair characters on calyx and midpetaline bands overlap between species, so this character is not independent. However, hair characters in combination with other

vegetative and/or reproductive characters enable the Peninsular Malaysia species to be identified.

Fruit characters that are useful in identifying *Erycibe* species include pedicel length, pedicel thickness, fruit shape, size, indumentum of the fruit and the shape of cotyledon.

3.5 Conclusions

The morphology of nineteen taxa of *Erycibe* had been investigated and the data were recorded in Tables 3.1 to 3.12. Results from the comparative morphological study of the genus *Erycibe* confirmed that there are nineteen morphologically distinct taxa. However, only seventeen taxa have scientific names with an additional two new taxa known as *Erycibe.* sp. A and *E.* sp. B as recognized by Ng (1989). The observations on morphological characters of seventeen taxa (excluding *E.* sp. A and *E.* sp. B) agree with most characters of the type specimens of *Erycibe* species. The two new taxa recognized by Ng (1989) as *E.* sp. A and *E.* sp. B, were also evaluated. These two new taxa are definitely different with the other seventeen recognized species in Peninsular Malaysia. *Erycibe* sp. A can be distinguished from other species based on the vegetative characters such as the leaf abaxial surface, midribs and petioles are densely stellate-hirsute, the tertiary veins is not conspicuous on the leaf abaxial surface, and the pedicels are absent or very short, about 1 mm long. *Erycibe* sp. B can be distinguished from other species based on several vegetative characters such as leaves are oval-elliptic to oblong, the tertiary veins is sunken or faintly conspicuous on the leaf abaxial surface and the lamina is usually drying brownish. The morphological characters of *E.* sp. A and *E.* sp. B need to be reevaluated when more specimens are available.

CHAPTER 4

TAXONOMIC TREATMENT

4.1 Introduction

Taxonomy is defined as a science that includes identification, nomenclature, and classification of objects, and usually restricted to objects of biological origin; when limited to plants, it is often known as systematic botany (Lawrence, 1951). By arranging the entities which the scientific names represent into a systematic classification, it allows one to deduce expected characteristics of a given taxon (such as species) from knowledge of its close relatives (Bridson & Forman, 1992). The preparation of taxonomic work also includes reference to the literature. All major precursory publications and type specimens or images were referred and studied to establish a basic species concept and correct nomenclature.

4.2 Materials and methods

The present taxonomic framework format is based on the Guide to Preparing Manuscripts for the Flora of Peninsular Malaysia (Kiew *et al*., 2006). The taxonomic treatments include generic, specific, and varietal taxonomic protologues, types, descriptions, habitats, vernacular names (if available), distributions, conservation status, and ecological notes. The protologues were obtained from the libraries of Forest Research Institute Malaysia (FRIM), library of Singapore Botanic Garden (SBG) and Botanicus Digital Library online at http://www.botanicus.org/browse. Type specimens were studied from the Herbarium of Singapore Botanic Garden (SING), Nationaal Herbarium Nederland

(L) and Royal Botanic Gardens, Kew (K) for comparison study. The descriptions are mainly based on herbarium specimens and fresh specimens. In species description italics are used to indicate diagnostic characters of the genus and species. Botanical illustrations were made to show the species' characters. Identification list for all specimens examined is also provided.

4.3 Results

Results of the present study showed that Peninsular Malaysia has 19 well-defined taxa but the two taxa recognized by Ng (1989) were remained as *Erycibe.* sp. A and *E.* sp. B, with the description of the taxa provided. Comparison were made between these two taxa with species occuring in nearby regions such as Peninsular Thailand, Borneo and a few specimens from Sumatra. *Erycibe.* sp. A, has similar characters as Borneo specimens (unnamed specimens) as discussed in section 4.3.2.18. However, none of these specimens has similar characters as *E.* sp. B.

4.3.1 The Genus *Erycibe*

***Erycibe* Roxb.**

(Greek word “erusibe” meaning mildew, probably referring to the trichome appearance)

Pl. Coromandel 2, 31 (1798) *t.* 159; Don, Gen. Hist. Dichl. Pl. 4 (1838) 392; De Candolle, Prodr. 9 (1845) 463; Clarke, Fl. Brit. India 4 (1883) 180; Prain, J. Asiat. Soc. Bengal 74, 2 (1906) 287; Hallier *f.*, *in* Engler, Bot. Jahrb. 16 (1893) 577, Bull. Herb. Boissier 5 (1897) 736; Ridley, Fl. Malay Pen. 2 (1923) 444; Hoogland in Ooststroom, Fl. Malesiana 4 (1953) 404; Hoogland, Blumea 7 (1953) 342; Ng, Tr. Fl. Malaya 4 (1989) 74; R.C. Fang & Staples in C.Y. Wu & P.H. Raven, Fl. China 16 (1995) 277; Staples *in* T. Santisuk & K. Larsen, Fl. Thailand 10, 3 (2010) 387. **Synonym:** *Fissipetalum* Merr., J. Straits Branch Roy. Asiat. Soc. 85 (1922) 168.

Woody climbers, shrubs, scandent shrubs, creepers or scramblers or small tree without latex. **Twigs** glabrous to hairy, sometimes lenticellate or longitudinal ridges; inner bark from pale yellow to pale brown to grayish or yellowish or creamy. **Leaves** simple, alternate**;** petiole terete, almost terete, slender or angular, glabrous to densely hairy, channelled or flat above at base; lamina variable in shape, ranging from elliptic to elliptic-oblong or ovate, oval-elliptic, rarely obovate, thin to thick coriaceous or chartaceous, base cuneate to obtuse, sometimes cordate, margin entire, flat or rarely revolute when dry, apex acute, acuminate, cuspidate to obtuse; midrib and lateral veins variable; intercostal veins reticulate to closely transverse order. **Inflorescences** terminal or axillary, solitary, racemose, paniculate or glomerules; bracts usually minute, caducous; pedicels hairy, usually with 2, sometimes fewer or more minute caducous bracteoles; bracteoles linear,

elliptic, ovate, obovate, oval or lanceolate, hairy outside, glabrous or almost glabrous inside. **Flowers** small, often fragrant; buds densely hairy; sepals 5, free, *persistent*, hairy outside or rarely glabrous, hairs stalked or sessile, 2-branched, stellate-hairy or dendritic, glabrous inside; corolla deeply 5-lobed, each lobe again *2-lobulate apically*, white to waxy white, tinge pink, cream, light yellowish to dark yellow or brownish grey, tube short, glabrous; midpetaline bands *densely hairy* outside, hairs stalked or sessile, 2-branched or stellate-hairy or dendritic, glabrous inside, lateral lobules thin, glabrous, coherent above the midpetaline bands, margin entire or minutely crenulate or crenate-serrate or sinuate, stamens 5, inserted above or at the corolla base; filaments broader at the base or slender, rarely sessile; anthers base cordate, almost cordate or broadly cordate or retuse or truncate apex acute to long acuminate or truncate or obtuse; pollen *smooth*; ovary about globose, glabrous or partly to completely hairy, 1-celled, 4-ovuled; *style none*, stigma sessile, conical, 5 or 10-ridges. **Fruit** berry like, coriaceous or scarcely fleshy, ellipsoid or ovoidor flattened-ellipsoid, rarely obpyriform and globular. **Seed** 1; cotyledon flat or folded.

Distribution. From western India and Sri Lanka across tropical and subtropical Asia as far east as the Philippines and southernmost Japan (Yakushima Island) and south through Malesia as far as Timor, New Guinea and the northern tip of Queensland, Australia; centered in South East Asia and Malesia.

Ecology. In secondary or primary forest from low to 1300 m altitude.

Notes. The genus has approximately 75 species. In Peninsular Malaysia, 19 taxa of *Erycibe* are recognized. Of the 19 taxa, two taxa (*E*. sp. A and *E*. sp. B) have not been described as

new taxa due to incomplete materials. Four taxa are endemic to Peninsular Malaysia; *E. magnifica*, *E. praecipua* ssp. *praecipua*, *E. sapotacea* and *E. strigosa*.

4.3.2 Key to *Erycibe* species and infraspecific taxon

1 Leaves small, less than 5.5 cm long and 2 cm wide. Lateral veins usually inconspicuous, 3 to 5 pairs. Flowers solitary ……*E. leucoxyloides*

Leaves longer and wider. Lateral veins usually conspicuous, 2 to 15 pairs. Flowers many in clusters ……..……2

2 Intercostal venation closely transverse order ……..……3

Intercostal venation reticulate ……5

3 Midrib prominent on both surfaces. Leaf chartaceous, lamina drying glossy green to pale brown to grey on both surfaces ……..…*E. stapfiana*

Midrib sunken above, prominent beneath. Leaf coriaceous, lamina drying dark brown to dark or brown reddish on both surfaces or at least beneath ……4

4 Leaf under surface, midribs and petioles densely stellate-hirsute. Intercostal venation faintly conspicuous on the abaxial leaf surface. Pedicels absent or very short, about 1 mm long ……...*E.* sp. A.

Leaf under surface almost glabrous, midribs and petioles glabrous. Intercostal venation prominent on the abaxial leaf surface. Pedicels longer, 5 to 6 mm long ……..…*E. griffithii*

5 Abaxial leaf surface hairy ……..…6

Abaxial leaf surface glabrous or nearly so ……...…11

6 Inflorescences terminal on shoots or lateral branches ……*E. expansa*

Inflorescences axillary to leaves ……7

7 Leaf apex long acuminate 1.4–1.6 cm long. Petioles, midribs and leaf under surface densely strigose-hairy ……....…*E. strigosa*

Leaf apex short acuminate, less than 1.4 cm long or cuspidate or obtuse. Petioles, midribs and leaf indumentum not as above ……...……8

8 Lamina thinly coriaceous, mature leaves small and narrow, 4–9 cm long, 1.5–4 cm width. Inflorescences near the apex of the branches, densely stellate-hirsute ……..*E. tomentosa* var. *hirsuta*

Lamina thickly coriaceous, mature leaves large and wide, 8.5–31 cm long, 4.5–11.5 cm width. Inflorescences not as above ……...…9

9 Leaf apex obtuse, margin strongly revolute when dry. Fruit indumentum densely long strigose-hairy ……...…*E. magnifica*

Leaf apex cuspidate, margin flat when dry. Fruit glabrous or sparsely short stellate-hairy ……..…10

10 Leaves broadly elliptic to oblanceolate. Intercostal venation prominent on the leaf under surface. Lamina usually drying pale green ……..…*E. citriniflora*

Leaves oval-elliptic to oblong. Intercostal venations sunken or faintly conspicuous on the leaf under surface. Lamina usually drying brownish ……...…*E.* sp. B

11 Habit consistently shrub or small tree to 6 m tall. Inflorescences usually glomerules (or flowers sometimes solitary). Sepals glabrous on both surfaces. Lamina drying always pale to dull greenish especially the under surface, margin usually revolute (rarely flat) when dry ……..…*E. albida*

Habit creeper, scrambler, scandent shrub or woody climber. Inflorescences racemose or paniculate. Sepals hairy on outer surface. Lamina drying darker or at least pale green, brown or yellowish, margin flat when dry ……12

12 Lamina typically obovate or broadly ovate, base almost cordate or obtuse. …...…13

Lamina ovate, elliptic or elliptic-oblong, base pointed or cuneate ……..14

13 Lamina glossy pale brown or yellowish on upper surface. Inflorescence racemose. Corolla lobule margins entire, longitudinal venation on lobules conspicuous. Unripe fruit bluish green, ripening to reddish orange, dry fruit surface smooth ……*E. malaccensis*

Lamina not glossy on upper surface. Inflorescence terminal leafy panicle (or flowers raceme in a short cluster). Corolla lobule margins crenate, longitudinal venation on lobules inconspicuous. Unripe fruit green to orange reddish, ripening to blackish, dry fruit surface wrinkled ……*E. tomentosa* var. *tomentosa*

14 Intercostal venation sunken on the abaxial leaf surface ……...…15

Intercostal venation prominent or at least faintly conspicuous on the abaxial leaf surface ……..…16

15 Lamina drying usually reddish and coriaceous. Corolla hairy on outside surface only. Anthers cordate at base, acuminate at apex. Fruits scarcely fleshy with scurfy surface. Cotyledons flat ……..…*E. aenea*

Lamina drying glossy yellowish brown and thick-coriaceous. Corolla hairy both on inside and outside surface. Anthers truncate at both ends. Fruits coriaceous and glabrous. Cotyledons strongly folded ……..…*E. praecipua* ssp. *praecipua*

16 Inflorescence paniculate, to 15 cm long, always with some leaves at basal part, downward passing into axillary ……*E. rheedii*

Inflorescence racemose, to 2 cm long, without leaves at basal part ……..…….17

17 Ovary appressed-hairy on upper part only. Stigma 10-ridged ……..……*E. festiva*

Ovary glabrous. Stigma 5-ridged ……..…18

18 Lamina drying dark brown or maroon on both surfaces. Petioles flat above at base. Anthers cordate at base, acuminate at apex. Fruits ellipsoid, dry fruit surface glabrous and smooth ……*E. maingayi*

Lamina drying glossy green on adaxial surface, dull green on abaxial surface. Petioles channelled above at base. Anthers truncate at both ends. Fruits ovoid, dry fruit surface wrinkled, fissured, with small white lenticels ……*E. sapotacea*

4.3.2.1 *Erycibe aenea* Prain

(Latin, *aeneus* = bronze, copper or copper red; referring to the rusty-hirsute hair on the branches and cymes)

J. As. Soc. Beng. 63, 2 (1894) 85, J. As. Soc. Beng. 74, 2 (1906) 295; Ridley, Fl. Malay Pen. 2 (1923) 446; Burkill & Henderson, Gard. Bull. S. S. 3 (1925) 400; Burkill, Econ. Prod. Malay Pen. 1 (1966) 958; Hoogland *in* Ooststroom, Fl. Malesiana 4 (1953) 424; Hoogland, Blumea 7, 2 (1953) 343; Ng, Tr. Fl. Malaya 4 (1989) 75. **Type:** *Kunstler 7337*, Peninsular Malaysia, Perak (lectotype CAL; isotypes B, G, K!, L [photo!], SING!)

A scandent creeper or woody climber to 4.5 m long, stem 5–7 cm diameter. **Twigs** terete; young branches stellate-hirsute, older almost glabrous with a few lenticels. **Leaves:** petioles terete, (5–)7–13 mm long, 1–2 mm thick, channelled above at base, densely stellate-hirsute; lamina elliptic to oblong or obovate, 7–15 × 3–4.5 cm, coriaceous, glabrous both sides, dry leaves always reddish or brown, base obtuse, margin flat, apex acuminate with obtuse tip; midrib sunken, glabrous above, prominent, sparsely to densely stellate-hairy beneath; lateral veins prominent both surfaces, (4–)5–8 pairs, *curving near the margin and joining with the next one to form a looped intramarginal vein*, sparsely stellate-

hairy but soon glabrescent beneath; intercostal veins reticulate, *sunken* both surfaces. **Inflorescences** terminal and axillary, racemose, sometimes 2 together, 1–4 cm long, 2–5(–10)-flowered; pedicels 1–2 mm long, densely stellate-hirsute; bracteoles linear, 1.5–2 × 0.5 mm, sparsely stellate-hirsute both surfaces. **Flowers:** buds to 2 mm diameter, densely stellate-hairy; two outer sepals orbicular to transverse oval, 2–2.3 × 2–2.8 mm, three inner sepals broadly elliptic, 2–2.5 × 3–3.5 mm, densely stellate-hirsute outside, hairs stalked, 7–8-subequal branched, longest branches to 530 μm long, longitudinal veins inconspicuous; corolla light yellow to yellow, 7–8.5 mm long, 9–10 mm across, tube 2–2.5 mm long; midpetaline bands 3–4 × 2–2.4 mm, hairs stalked or sessile, 5–7-branched, lower part subequal branched, upper part unequal branched with one distinctly longer and stronger, to 530 μm long; corolla lobes *c*. 5 mm long, *c*. 4 mm across; lobules coherent above the midpetaline at *c*. 1.5 mm, oblong, 3–5 x 2 mm, margin minutely crenulate, longitudinal venation conspicuous; stamens inserted 0.7–0.8 mm above corolla base; filaments 1.2–1.5 mm long, broader at the base; anthers 0.5–0.8 mm long, 0.6–0.8 mm thick, base cordate, apex acuminate; ovary *c.* 1 × 1–1.3 mm, glabrous or at least glabrous at lower part, sparsely hirsute at apex; stigma 10-ridged. **Fruits:** pedicel 1–2(–4) mm long, 1–2 mm thick, densely stellate-hirsute; ovoid or ellipsoid, 1.2–2.5 × 1–1.9 cm, obtuse at both ends; exocarp scarcely fleshy, thick, *scurfy*, immature greenish to grayish brown, ripening unknown; mesocarp unknown. **Seed** ellipsoid, *c*. 0.9 × 1 cm; cotyledon flat.

Vernacular name. Langsat hutan (Malay).

Distribution. Peninsular Malaysia and Sumatra. In Peninsular Malaysia known from Perak, Selangor, Kelantan, Pahang and Johor.

Conservation status. Least Concern (LC).

Ecology. It usually climbs on large trees in primary forest and hill sides to 760 m altitude, in secondary forest or open and logged-over forest and on roadsides. Flowering in March and October, and fruiting in July, September and October.

Uses. The root is used medicinally in Pahang as an 'ubat meroyan', a decoction being administered as a protective draught during first three days after childbirth (Burkill, 1966).

Notes and discussion.

1. The fruits of *Erycibe aenea* are scurfy like *E. griffithii* but differ from other species.
2. The lateral veins are prominent on both surfaces, curving near the margin and joining with the next one to form a looped intramarginal vein.
3. The dry leaves are usually reddish in colour and the intercostal veins are reticulate and sunken on both surfaces, which make this species easier to distinguish from other species.

Specimens examined. JOHOR. Labis F.R., Cpt. 27, *Kochummen, K.M. FRI 16078,* 25 Jul 1970 (KEP,SING); Mawai-Jemaluang Road, 14th Mile, *Corner, E.J.H. SFN 37362,* 1 September 1940 (SING,K,L); Mawai-Kota Tinggi Road, 5.5th Mile, *Corner, E.J.H. SFN 29308,* 10 May 1935 (KEP,SING); Tenggaroh F.R., *Chan, Y.C. FRI 66786,* 21 September 2010 (KEP,SAN,SING,L,K,A,SAR,CNS) – **KELANTAN.** Relai F.R., Cpt. 33, *Cockburn, P.F. FRI 7217,* 17 Oct 1967 (KEP,L,SING) – **PAHANG.** Kemasul F.R., *Hamid FMS 10872,* 17 Oct 1925 (KEP); Ulu Gali, *Burkill, I.H. 16248,* 13 November 1924 (SING) – **PERAK.** Gopeng, *King's collector 8165* (K); Larut, *King's collector 7337,* March 1885

(SING,K,L) – S**ELANGOR.** Bkt. Enggang, *Symington, C.F. FMS 24095*, 31 Mar 1930 (KEP,SING); Sg. Lalang F.R., *Symington, C.F. FMS 22859*, 18 Mar 1930 (KEP).

4.3.2.2 *Erycibe albida* Prain **Fig. 4.1 & Fig. 4.2**

(Latin, *albidus* = whitish)

J. As. Soc. Beng. 63, 2 (1894) 87; Hoogland *in* Ooststroom, Fl. Malesiana 4 (1953) 414; Hoogland, Blumea 7 (1953) 344; Ng, Tr. Fl. Malaya 4 (1989) 75; Kochummen, Tr. Fl. Pasoh For. (1997) 173; Staples *in* T. Santisuk & K. Larsen, Fl. Thailand 10, 3 (2010) 389. **Type:** *Kunstler 7373*, Peninsular Malaysia, Perak, Gn. Boobo (Bubu) (lectotype CAL; isolectotypes B, BM, G, K!, L! [photo!]); *Curtis 2947*, Thailand, Pungah (syntypes K!, SING!); *Scortechini s.n.*, Peninsular Malaysia, Perak, Larut (syntype CAL). **Misapplied name:** *Erycibe glomerata* Auct. *non* Blume, Bijdr. Fl. Ned. Ind. 16, (1826) 1047; Hallier *f.* Bull. Herb. Boissier 5 (1897) 17 & 739; Prain, J. As. Soc. Beng. 74, 2 (1906) 294; Ridley, Fl. Malay Pen. 2 (1923) 447; *Erycibe glomerata* var. *typica* Auct. *non* Prain, J. As. Soc. Beng. 74, 2 (1906) 294; Ridley, Fl. Malay Pen. 2 (1923) 448; *Erycibe glomerata* var. *longifolia* Auct. *non* Blume; Prain, J. As. Soc. Beng. 74, 2 (1906) 295; Ridley, Fl. Malay Pen. 2 (1923) 448.

Shrub or *small tree* to 6 m tall, stem 3 cm diameter. **Twigs** almost terete; young branches strigose, older glabrescent with faint longitudinal ridges and a few lenticels; inner bark pale yellow to brown. **Leaves:** petioles angular, 11–15(–20) mm long, 1–2(–6) mm thick, channelled above at base, glabrous; laminas oblong to oblanceolate or elliptic-oblong, 12–24(–40) × 4.5–8.7(–12) cm, thinly coriaceous to coriaceous, almost glabrous on both surfaces, dry leaves always *pale or dull greenish*, base cuneate, margin always *revolute*

when dry, rarely flat, apex acuminate; midrib sunken above, prominent beneath; lateral veins prominent both sides, 6–10(–15) pairs, sometimes ending close to margin; intercostal veins reticulate, faint or inconspicuous both sides. **Inflorescences** axillary, *solitary* or *glomerules*, to 1.2 cm long, (1–)2–12(–15)-flowered; pedicels 1–3 mm long, strigose but soon glabrescent; bracteoles ovate, *c.* 1 × 1 mm, sparsely stellate-hairy on both surfaces. **Flowers:** buds to 2.5 mm diameter, densely stellate-hairy; two outer sepals orbicular, 2–2.5 × 2–2.5 mm, three inner sepals broadly elliptic, 2.3–2.8 × 2.5–3 mm, pale green, always *glabrous* outside, longitudinal veins conspicuous; corolla white or waxy white, 11–13 mm long, 14–16 mm across, tube 1.5–2 mm long; midpetaline bands 5–7.5 × 0.5–1.5 mm, thickened fleshy, densely stellate-hairy, hairs stalked or sessile, dendritic, 3–4-unequal branched, longest branches to 708 μm long; corolla lobes 8–9 mm long, 5–6 mm across; lobules coherent above the midpetaline bands at *c.* 1.5 mm, oblong, 4–9 × 2–6 mm, margin entire or minutely crenate-serrate, longitudinal venation conspicuous; stamens inserted 0.5–1 mm above the corolla base; filaments 0.5–2.5 mm long, broader at the base; anthers 1–1.5 mm long, 0.5–0.7 mm thick, base broadly cordate, apex acute; ovary 1.7–2.1 × 0.8–0.9 mm, glabrous; stigma 5 faint to distinct ridges. **Fruit:** pedicel 4–5 mm long, 1 mm thick, glabrous; ellipsoid, 1.5–2.5 × 0.5–1 cm, tapering at both ends; exocarp probably scarcely fleshy, glabrous, smooth, immature green to light yellow, ripening unknown; mesocarp fleshy. **Seed** ovoid to ellipsoid, 1.8–2 × 0.6–0.8 cm; cotyledon flat.

Distribution. Peninsular Thailand, Peninsular Malaysia and Sumatra. In Peninsular Malaysia, known from Kedah, Perak, Kelantan, Terengganu, Pahang, Selangor, Negeri Sembilan, Melaka and Johor.

Conservation status. Least Concern (LC).

Ecology. Found in primary, swampy forest, on flat land and hill side at 60–915 m altitude. Flowering in January, February, March, April, July, August and December and fruiting in February, April, June, October and November.

Uses. Not recorded.

Notes and discussion.

1. *Erycibe albida* is the only species in Peninsular Malaysia that has glabrous or almost glabrous calyx.
2. The lamina margin always revolute (rarely flat) when dry.

Specimens examined. JOHOR. Sg. Endau, *Kuthubuthee & Chan W.S KLU 18580* (KLU); G. Chabang Tiga, *Mohd Hairul, M.A. FRI 58982,* 28 August 2007 (KEP,SAN,SING,L); Mawai-Kota Tinggi Road, 7th Mile, *Corner, E.J.H. SFN 28717,* 4 Feb 1935 (KEP,SING,K); Mawai-Jemaluang Rd., Sg. Kayu Ara, *Corner, E.J.H. s.n.,* 10 February 1935 (SING); Sg. Juasseh, *Mohd Shah MS 2323,* 1 February 1971 (SING,L); G. Ledang F.R., Sg. Belemang, *Whitmore, T.C. FRI 12335,* 15 Jul 1969 (KEP) – **KEDAH.** P. Langkawi, *Zainudin, A. AIM 1182* (K); G. Raya F.R., *Zainudin, A. AZ 1229,* 19 February 1984 (SING); P. Dayang Bunting, *Siti Munirah, M.Y. FRI 55333.* 16 Mar 2007 (KEP); Sg. Batu Asah, *Mohd Haniff 15488* (SING) – **KELANTAN.** Stong Utara F.R., G. Stong, *Symington, C.F. FMS 37637,* 10 Oct 1934 (KEP) – **MELAKA.** Malacca, *Alvins, M.V. 1307,* 12 March 1885 (SING) – **NEGERI SEMBILAN.** Pasoh F.R., *Gardette, E. EG 1919,* 5 Jun 1996 (KEP,L,SING); *Gardette, E. EG 2060,* 20 June 1996 (L); *Gardette, E. EG 2201,* 4 Sep 1996 (KEP,L,SING); Sg. Menyala F.R., *Kochummen, K.M. FRI 16441,* 22 Feb 1972 (KEP,L,K) – **PAHANG.** Cameron Highlands, *Ridley, H.N. 2989,* February 1890

(SING); Krau W.R., Bkt. Tapah, *Everett, B. FRI 13607*, 9 Nov 1969 (KEP) – **PERAK.** Waterloo Estate, *Curtis, C. 1283,* December 1887 (SING); Tapah, *Wray, L. 2580,* July 1888 (SING); Trolak F.R., *Jaamat FMS 43481,* 16 Feb 1937 (KEP); G. Bujang Melaka, *Unknown 9649* (SING); Sg. Penoh, *Sow FMS 47230,* 21 Jun 1938 (KEP); Kati, *Mohd Haniff 14962,* 17 Jan 1925 (SING); Bubu F.R., Sg. Gebul, *Symington, C.F. FMS 30707,* 3 Apr 1933 (KEP); G. Bubu, *King's collector 7373* (L,K) – S**ELANGOR.** Forest Research Institute Malaysia, *Asnah, H. FRI 35599,* 6 Apr 2005 (K, KEP, L, SAN, SING); Gombak Rd., 11th Mile, *Hashim, P. KL 9,* 19 Mar 1957 (KEP); Sg. Lalang F.R., *Symington, C.F. FMS 24162,* 7 Apr 1930 (KEP); Kuala Pansom, *Gadoh, U. KL 464*, 2 Jul 1958 (KEP); *Gadoh, U. KL 756,* 19 Aug 1956 (KEP); Kuala Lumpur, *Ridley, H.N. s.n.* (SING) – **TERENGGANU.** Tembat F.R., *Ummul Nazrah, A.R. FRI 57214,* 5 April 2009 (KEP, SAN, SING, L, K, A).

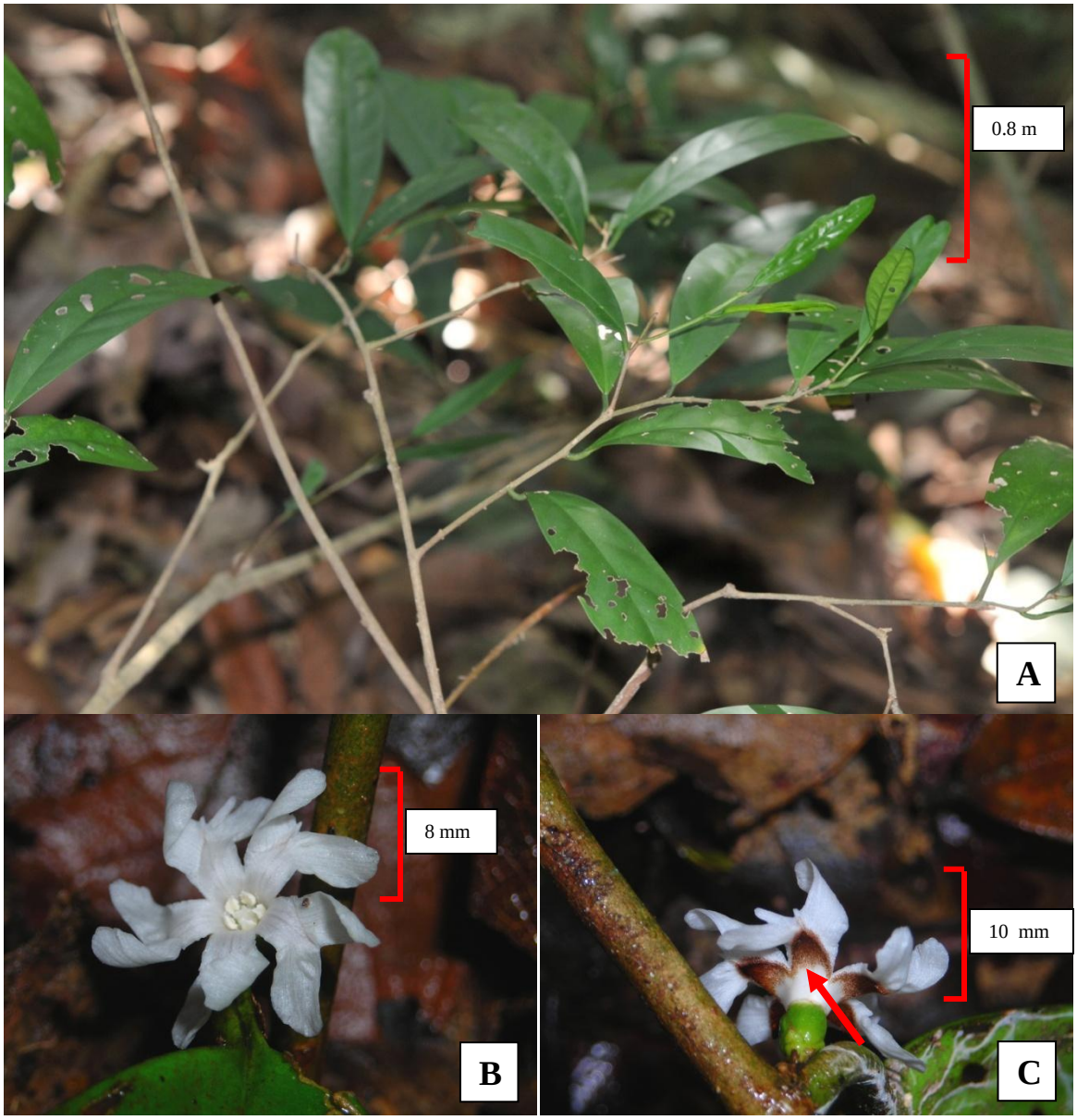

Fig. 4.1. *Erycibe albida* Prain. A, Habit; B, Solitary flower; C, Hairy midpetaline bands.

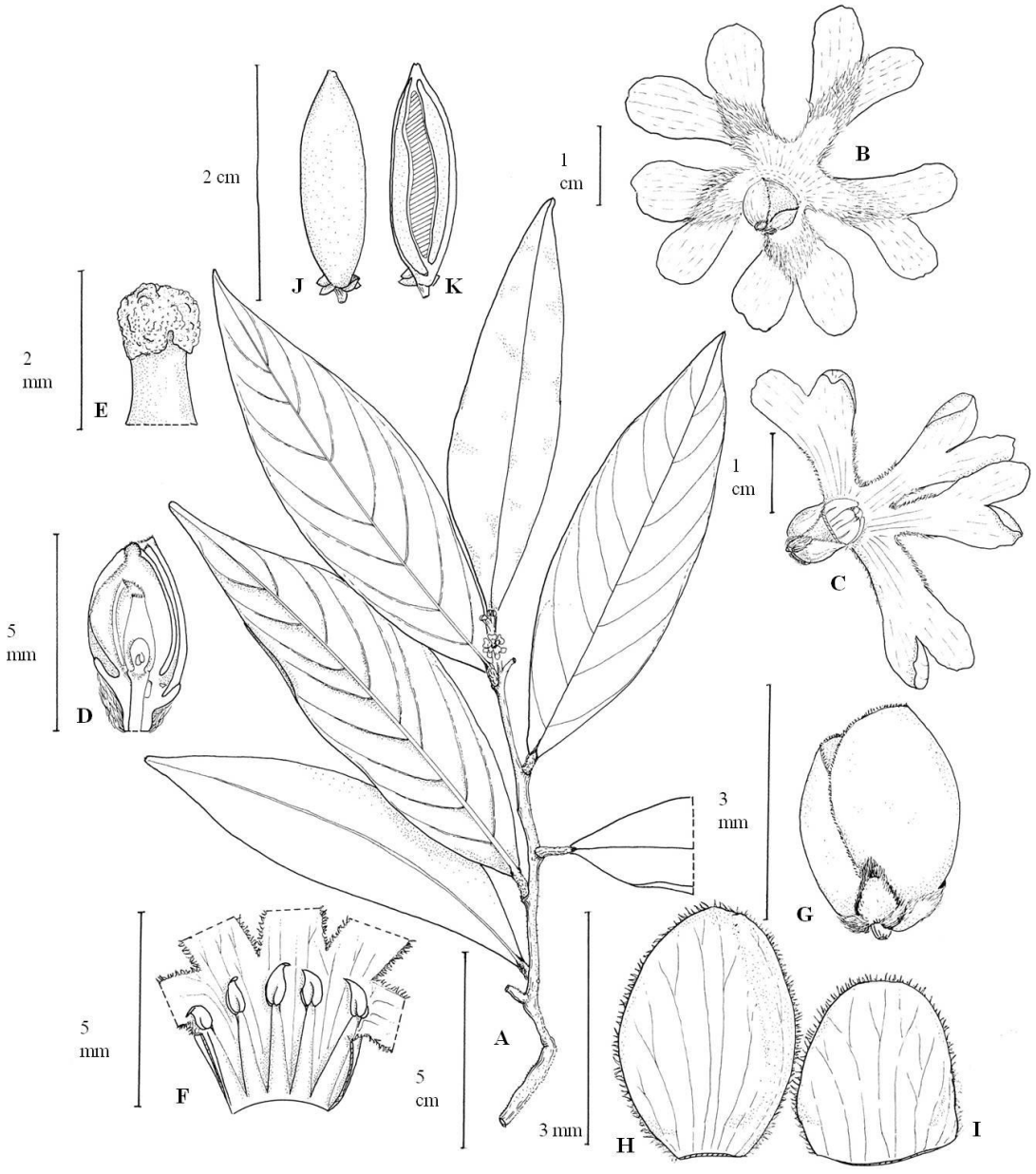

Fig. 4.2. Illustration of *Erycibe albida* Prain. A, habit; B, flower from basal view; C, flower with one petal removed; D, longitudinal section of flower bud; E, stigma; F, stamens; G, calyx; H, inner sepal; I; outer sepal; J, fruit; K, longitudinal section of fruit. (A–C & E–I from *FRI57214*, D from *FRI58006*, J–K from *47230*).

4.3.2.3 *Erycibe citriniflora* Griff. **Fig. 4.3**

(Latin, *citrinus* = lemon yellow, *flora* = flower; referring to the flower colour)

Not. Pl. Asiat. 4 (1854) 284; Prain, J. As. Soc. Beng. 73, 2 (1903) 17; Brandis, Indian Trees (1906) 714; Ridley, Fl. Malay Pen. 2 (1923) 445; Hoogland *in* Ooststroom, Fl. Malesiana 4 (1953) 425; Hoogland, Blumea 7 (1953) 345; Ng, Tr. Fl. Malaya 4 (1989) 75; Staples, Fl. Thailand 10, 3 (2010) 390. **Type:** *Griffith 390* (= Kew Distr. No. 5881), Birma and Malay Peninsula (lectotype K; isotypes K, P [photo!]).

Woody climber or scandent shrub to 7.6 m tall. **Twigs** terete; young branches densely strigose, older almost glabrous with a few lenticels; inner bark pale brown. **Leaves:** petioles almost terete, 8–12 mm long, 1.3(–2) mm thick, channelled above at base, densely hairy, soon glabrescent; laminas broadly elliptic to oblanceolate, (12–)21–24(–31) × (4.5–)7–11.5 cm, coriaceous, young leaves densely hairy soon glabrescent at maturity, dry leaves pale green to reddish, base attenuate to almost cordate, margin flat, apex cuspidate; midrib sunken above, glabrous, prominent beneath, densely stellate-hairy; lateral veins sunken above, prominent beneath, 8–11(–14) pairs, sometimes curving close to margin and join with the next one to form a looped intramarginal vein, puberulous; intercostal veins reticulate, inconspicuous above, prominent beneath. **Inflorescences** axillary, *dense glomerules*, to 25-flowered; pedicels 1–3 mm long, densely stellate-hairy; bracteoles linear, 2.5–4 × 1 mm, densely stellate-hairy both sides. **Flowers:** buds to 4 mm diameter, densely stellate-hairy; two outer sepals orbicular, *c.* 3 × 3 mm, three inner sepals transverse oval, 2–2.5 × 2.5–3 mm, stellate-hirsute outside, hairs stalked, 4–5-unequal branched, with one branch longer, to 360 μm long, longitudinal veins inconspicuous; corolla yellowish, 10–20 mm long, *c.* 10 mm across, tube 1.5–2 mm long; midpetaline bands 3.5–4 × 3 mm,

thickened fleshy, densely stellate-hairy, hairs sessile, 4–6-unequal branched, with one branch longer, to 484 μm long; corolla lobes 3–4 mm long, 2–3 mm across; lobules coherent above the midpetaline bands at *c*. 3 mm, oblong, 1.5–2 × 1.5 mm, margin entire, longitudinal venation inconspicuous; stamens inserted at the corolla base; filaments 1–1.5 mm long, broader at the base; anthers 1–1.5 mm long, 0.5–0.7 mm thick, base broadly cordate, apex acute to acuminate; ovary 1.7–2.1 × 0.8–0.9 mm, glabrous or densely hirsute; stigma 10-ridged. **Fruit:** pedicel 2.3–4.5 mm long, *c.* 1 mm thick, shortly stellate-hairy; ellipsoid, 2.5–3.3 × 2–2.4 cm, base and apex obtuse; exocarp coriaceous, glabrous or sparsely short stellate-hairy, immature unknown, ripening purple; mesocarp unknown. **Seed** ellipsoid, *c.* 2 × 1.4 cm; cotyledon flat.

Distribution. Peninsular Thailand, Peninsular Malaysia and southern Myanmar. In Peninsular Malaysia, known from Johor, Penang, Selangor and Terengganu.

Conservation status. Least Concern (LC).

Ecology. It grows at low altitudes to 600 m both in the primary forest (at ridge top, hillside, and sometimes near rivers) and in secondary forests at rubber export station by roadsides. Flowering in May, June and fruiting in February and October. Flowers smell like tree bug.

Uses. Not recorded.

Notes and discussion.

1. Although *Erycibe citriniflora* has glomerules inflorescence and drying pale green lamina similar to *E. albida*, it can be differentiate by the lamina shape (oblong to

elliptic oblong in *E. albida*, but broadly elliptic to oblanceolate in *E. citriniflora*) and intercostals venations more prominent in *E. citriniflora*.

Specimens examined. JOHOR. Sg. Ayer Hitam Besar, *Sinclair, J. SFN 40245,* 8 April 1954 (SING); Kluang F.R., *Cockburn, P.F. FRI 7538,* 8 Feb 1968 (KEP,K,L,SING) – **PENANG.** Waterfall Garden, *Curtis, C. 2837,* May 1892 (SING) – **SELANGOR.** Genting Sempah, *Mohd Nur SFN 34317,* 30 October 1937 (SING,L,K); Sg. Buloh, *Unknown s.n.,* 31 May 1955 (SING) – **TERENGGANU.** Taman Negara, Batu Bidan, *Cockburn, P.F. FRI 10591,* 11 Jun 1968 (KEP,K,L,SING); Jalan Syed Zain, *Sinclair, J. SFN 39827,* 5 July 1953 (SING).

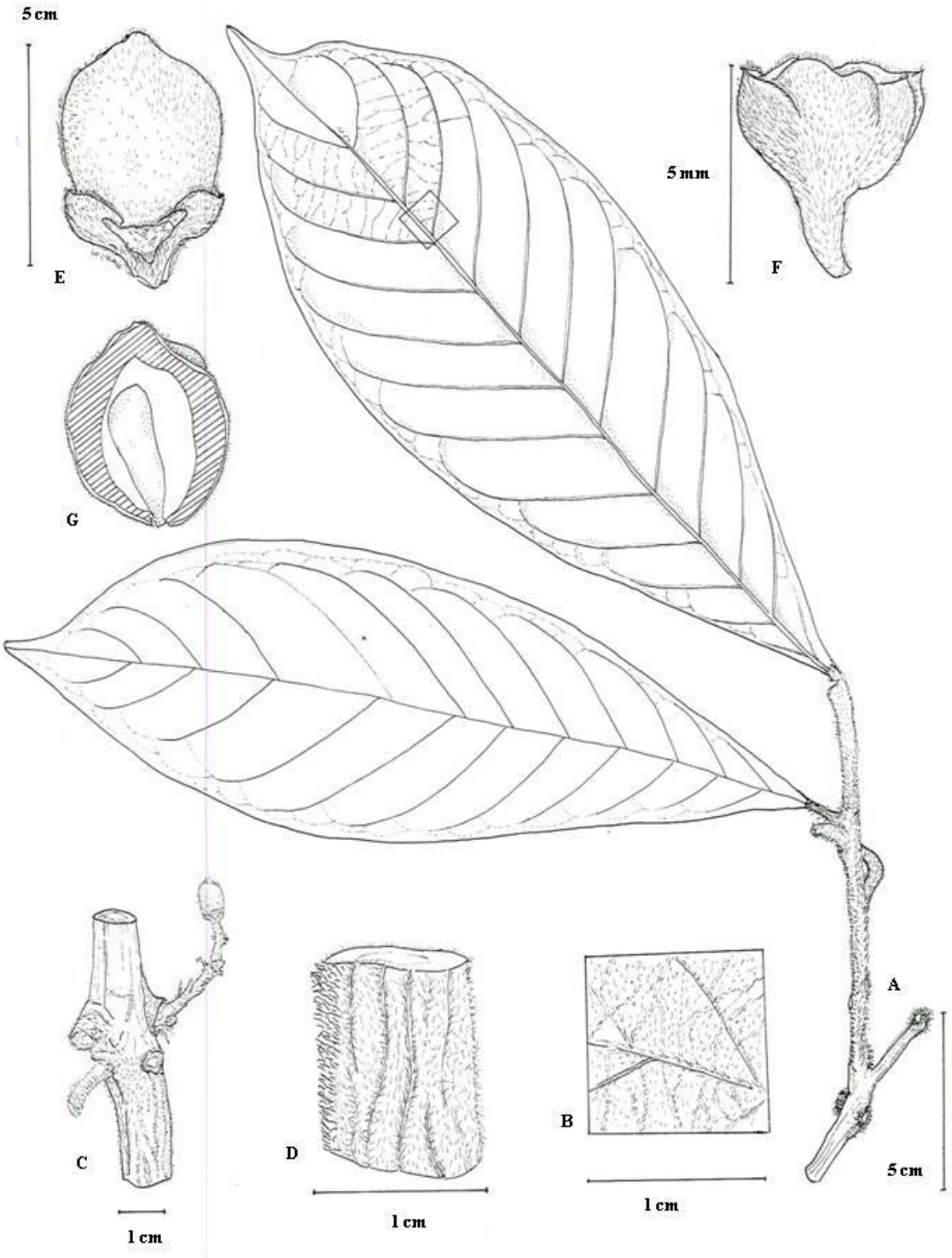

Fig. 4.3. Illustration of *Erycibe citriniflora* Griff. A, habit; B, leaf venation; C, infructescence twig; D, hairy twig surface; E, fruit; F, calyx; G, longitudinal section of fruit (A–G from *FRI7538*).

4.3.2.4 *Erycibe expansa* Wall. *ex* G. Don

(Latin, *expansa* = spreading; probably referring to large size of the climber)

Gen. Hist. Dichl. Pl. 4 (1838) 392; Clarke, Fl. Brit. India 4 (1883) 181; Prain, J. As. Soc. Beng. 63, 2 (1894) 84; Brandis, Indian Trees (1906) 483; Prain, J. As. Soc. Beng. 74, 2 (1906) 289; Ridley, Fl. Malay Pen. 2 (1923) 445; Hoogland *in* Ooststroom, Fl. Malesiana 4 (1953) 426; Hoogland, Blumea 7 (1953) 346; Ng, Tr. Fl. Malaya 4 (1989) 76; R.C. Fang & Staples *in* C.Y. Wu & P.H. Raven, Fl. China 16 (1995) 278; Staples *in* T. Santisuk & K. Larsen, Fl. Thailand 10, 3 (2010) 392. **Type:** *Wallich 1331/2*, Myanmar, Tavoy (lectotype K; isotypes K, G).

Climber or scandent shrub. **Twigs** terete; young branches tomentose, older brown hairy with longitudinally ridged. **Leaves:** petioles terete, 2–5 mm long, 1–2 mm thick, hairy to densely hairy; laminas elliptic to broadly elliptic, 2.2–7 × 1.4–4.5 cm, coriaceous, glabrous above, stellate-hairy beneath, dry leaves reddish or dark brown, base obtuse or sometimes cordate, margin flat, apex shortly acute or rarely *rounded*; midrib always sunken above, glabrous, prominent beneath, glabrous; lateral veins prominent both sides, (2–)3–4 pairs, ending close to margin, lower and middle pair usually opposite, stellate-hirsute; intercostal veins reticulate, conspicuous on both sides. **Inflorescences** terminal, paniculate, (12–)15–21 cm long, (2–)5–10(–12)-flowered; pedicels 1–3 mm long, densely stellate-hairy; bracteoles linear, 1–2 × 0.5–1 mm, sparsely stellate-hairy both sides. **Flowers:** buds to 3 mm diameter, densely stellate-hairy; all sepals *subequal*, elliptic, 1.5–2 × 1.2–1.5 mm, densely stellate-hairy outside, hairs stalked, 3–5-subequal branched, to 340 μm long, longitudinal veins inconspicuous; corolla white or tinged pink, *c*. 8 mm long, *c*. 10 mm across, tube 1.3–1.7 mm long; midpetaline bands 3.5–4 × 1.5–1.8 mm, thickened fleshy,

densely stellate-hairy, hairs stalked, 4–5-subequal branched, to 491 μm long; lobes 4–6 mm long, 4–5 mm across; lobules coherent above the midpetaline bands at *c*. 2 mm, oblong, 3–3.5 × 2 mm, margin entire or slightly crenulate, longitudinal venation inconspicuous; stamens inserted at the corolla base; filaments 1.3–1.5 mm long, broader at the base; anthers 1.3–1.5 mm long, 1 mm thick, base almost cordate, apex long acuminate; ovary *c*. 0.8 × 1 mm, glabrous; stigma 5-ridged. **Fruits** unknown.

Distribution. China (Yunnan), Southern Myanmar, Peninsular Thailand, Peninsular Malaysia and probably in the Nicobar Islands, India. In Peninsular Malaysia, known only from Kedah (including Langkawi Island).

Conservation status. Near Threatened (NT).

Ecology. No record for habitat but reported to occur at 30 m altitude in Peninsular Malaysia. In Thailand, it occurs in scrub, or evergreen forest stream bank, often in marshy or swampy habitats. Flowering in February, September and November.

Uses. Not recorded.

Notes and discussion.

1. The pink tinged colour on the corolla is believed to be due to red hairs on midpetaline bands.
2. None of the Peninsular Malaysia specimens has fruit, however, according to Hoogland in Ooststroom (1953a), the fruit is said to be ellipsoid, 12 × 6 mm, glabrous, and has flat cotyledon.

Specimens examined. KEDAH. Kg. Naka, *Holttum, R.E. 19830,* 9 September 1933 (SING,K); Kuah, *Mohd Haniff 15476,* February 1911 (SING,K); P. Langkawi, *Mohd Haniff s.n = 2128,* September 1900 (SING); Kuah, *Curtis, C. 2128,* November 1889 (SING).

4.3.2.5 *Erycibe festiva* Prain

(Latin, *festivus* = bright)

J. As. Soc. Beng. 63, 2 (1894) 87, J. As. Soc. Beng. 65, 2 (1896) 536, J. As. Soc. Beng. 74, 2 (1906) 292; Ridley, Fl. Malay Pen. 2 (1923) 447; Burkill & Henderson, Gard. Bull. S. S. 3 (1925) 400; Hoogland *in* Ooststroom, Fl. Malesiana 4 (1953) 417; Hoogland, Blumea 7, 2 (1953) 347; Ng, Tr. Fl. Malaya 4 (1989) 76. **Type:** *Kunstler 6445*, Peninsular Malaysia, Perak, Larut (lectotype CAL; isolectotypes B, BM!, G, K!, L! (photo KEP!), SING!, UC); *Hullet 624,* Singapore (syntype CAL).

Creeper or scrambler to 20 m long, stem 7.5 cm diameter. **Twigs** terete; young branches sparsely strigose-hairy, older glabrescent with a few lenticels. **Leaves:** petioles *slender, long*, 8–10 mm long, 1–2 mm thick, channeled above at base, sparsely stellate-hirsute or sometimes glabrous; laminas elliptic-oblong, 7–14 × 3–7 cm, coriaceous, glabrous on both surfaces, dry leaves dull brown, base cuneate, margin flat, apex acuminate; midrib sunken above, glabrous, prominent beneath, glabrous; lateral veins prominent both surfaces, 6–9 pairs, slightly curving near the margin, glabrescent beneath; intercostal veins reticulate, inconspicuous above, faintly conspicuous beneath. **Inflorescences** axillary, racemose, to 1.5 cm long, (2–)4–6(–11)-flowered; pedicels 1.5–4 mm long, densely stellate-hirsute; bracteoles lanceolate, *c.* 2 × 0.5 mm, densely hirsute both sides. **Flowers:** buds to 2 mm

diameter, densely hirsute; two outer sepals orbicular, 2–2.5 × 2–2.5 mm, three inner sepals transverse oval, 2–2.5 × 3 mm, densely appressed-hairy outside, hairs sessile, 2-subequal branched, branches to 160 μm long, longitudinal veins conspicuous; corolla pale greenish white, *c*. 5 mm long, *c*. 8 mm across, tube *c*. 1 mm long; midpetaline bands *c*. 5 × 3 mm, densely appressed-hairy, hairs stalked, 2-unequal branched, with one branch longer, to 405 μm long; corolla lobes 5–6 mm long, *c*. 2 mm across; lobules coherent above the midpetaline bands at *c*. 1 mm, oblong, 3.5–4.5 × 3–3.5 mm, margin slightly crenate, longitudinal venation inconspicuous; stamens inserted at the corolla base; filaments 0.5–1 mm long, broader at the base; anthers *c*. 1.8 mm long, 0.5–0.6 mm thick, base broadly cordate, apex acute; ovary 1–1.5 × 1.3–1.7 mm, *appressed-hairy at upper part only*; stigma 10 faint to distinct ridges. **Fruit** unknown.

Distribution: Peninsular Malaysia, Singapore, Banka and west Java. In Peninsular Malaysia, recorded only in Perak.

Conservation status. Endangered (EN) B1ab(iii).

Ecology: In open forest, rocky area to 200 m altitude. Flowering in February and August.

Uses. Not recorded.

Notes and discussion.

1. Prain (1894) mentioned that *E. festiva* closely resembles *E. albida*, but greatly differs in tomentum character (tomentose midpetaline bands in *E. festiva*), flower size (larger in

E. albida) and shape of corolla lobules (lobules oblong in *E. albida*). From my observation, sterile specimens are difficult to be distinguished, except for the revolute lamina margin in *E. albida*. However, hair characters both on midpetaline bands and calyx are very useful (when flowers are present). Only 2-branched hairs occur both on midpetaline bands and calyx in *E. festiva*.

2. Fruit was not observed in *E. festiva*, so no conclusion can be made for the fruit character.

Specimens examined. PERAK. Kuala Dipang F.R., *Sidek, K. SK 513,* 19 Feb 1976 (KEP,SING); Larut, *King's collector 6445,* August 1884 (SING,K,L).

4.3.2.6 *Erycibe griffithii* C.B Clarke **Fig. 4.4**

(William Griffith, 1810–1845, civil surgeon the East India Company in Melaka in mid 1841)

Fl. Brit. India 4 (1883) 182; Prain, J. As. Soc. Beng. 63, 2 (1894) 85; Hallier *f*., Bull. Herb. Boissier 5 (1897) 738; Brandis, Indian Trees (1906) 295; Ridley, Fl. Malay Pen. 2 (1923) 447; Burkill & Henderson, Gard. Bull. S. S. 3 (1925) 400; Hoogland *in* Ooststroom, Fl. Malesiana 4 (1953) 411, fig. 13; Hoogland, Blumea 7 (1953) 349; Ng, Tr. Fl. Malaya 4 (1989) 75; Staples *in* T. Santisuk & K. Larsen, Fl. Thailand 10, 3 (2010) 392. **Type:** *Griffith s.n.* (= Kew Distr. No. 5880), Myanmar, Mergui (lectotype K!); *Maingay 2572* (= Kew Distr. No. 1520), Peninsular Malaysia, Melaka (syntype K!).

Scandent shrub or woody climber to 40 m tall, stem 3.5 cm diameter. **Bole** more or less fluted. **Twigs** terete; young branches stellate-hairy, older glabrescent, faint longitudinal

ridges with a few lenticels; outer bark grey, inner bark yellowish. **Leaves:** petioles terete, 8–12 mm long, *c.* 1 mm thick, *glabrous*; laminas elliptic-oblong to ovate-oblong, (7.5–)8.5–14.5 × (2.8–)4.1–8 cm, coriaceous, almost glabrous both surfaces, dry leaves always *dark brown or brown reddish*, base cuneate to obtuse, margin flat, apex acuminate; midrib sunken above, *glabrous*, prominent beneath, *glabrous*; lateral veins prominent both sides, 5–8 pairs, ending close to margin; intercostal veins closely *transverse order*, faintly conspicuous above, usually *prominent* beneath. **Inflorescences** axillary, solitary or sometimes 3–4 together, to 1.2 cm long, (1–)3–8-flowered; pedicels 5–6 mm long, strigose; bracteoles linear, 1–1.5 × 0.5–1 mm, densely stellate-hairy both sides. **Flowers:** buds to 3 mm diameter, densely stellate-hairy; two outer sepals broad-ovate or triangular-ovate, 1.8–2 × 2 mm, three inner sepals transverse oval, 2.5–2.7 × 3–3.5 mm, densely stellate-hairy outside, hairs stalked, 2–3-subequal branched, generally curled hairs, longest branches to 310 μm long, longitudinal veins inconspicuous; corolla white, 6–7 mm long, 5–6 mm across, tube 1.5–2.5 mm long; midpetaline bands 4.5–5 × 3–3.5 mm, thickened fleshy, densely stellate-hairy, hairs stalked, 3–5-subequal branched, longest branches to 440 μm long; corolla lobes 4–5 mm long, 2–2.5 mm across; lobules coherent above the midpetaline bands at *c*. 2.5 mm, oblong, 2–2.8 × 2–2.5 mm, margin entire or slightly crenulate, longitudinal venation inconspicuous; stamens inserted 1–1.5 mm above the corolla base; anthers *sessile*, 0.4–0.5 mm long, 0.7–0.8 mm thick, *retuse* at both ends; ovary 1.5–2 × 1–1.5 mm, glabrous; stigma 10-ridged. **Fruits:** pedicel 0.6–1.6 mm long, *c.* 1 mm long, sparsely stellate-hairy; ellipsoid or ovoid, 1.5–3.5 × 1–1.7 cm, tapering-obtuse at both ends; exocarp probably scarcely fleshy, thick, scurfy, immature grayish brown when dry, ripening orange; mesocarp fleshy. **Seed** ellipsoid; cotyledon folded.

Vernacular name. Akar Kemalau (Temuan).

Distribution. India, Indo-China, southern Myanmar, Vietnam, Peninsular Thailand and Peninsular Malaysia. In Peninsular Malaysia, known from Perlis, Penang, Perak, Kelantan, Selangor, Negeri Sembilan and Melaka.

Conservation status. Least Concern (LC).

Ecology. Found in primary lowland and dense forest, foot hill and hill side 150–760 m altitude. Flowering in February, April, July, October and fruiting in July, August, September

Uses. Not recorded.

Notes and discussion.

1. Among all the species studied, only *Erycibe griffithii* has sessile stamens.

Specimens examined. KELANTAN. Sg. Long, *Latiff, A. ALM 1850, 26* Sep 1986 (UKMB) – **MELAKA.** Melaka, *Maingay, A.C. 2572* (K) – **NEGERI SEMBILAN.** Pasoh F.R., *Gardette, E. EG 2250,* 19 Sep 1996 (KEP,L,K,SING) – **PENANG.** Penang, *Fox, W. 12,* July 1899 (SING); Western Hill, *Curtis, C. 1540,* February 1885 (SING); Government Hill, *Curtis, C. 181,* July 1893 (SING); Waterfall Garden, *Burkill, I.M. 2695,* 31 July 1917 (SING); Penang Hill, *Kochummen, K.M. FRI 29338,* 8 Sep 1982 (KEP,L,K); Ayer Hitam, *Mohd Haniff 3439,* 14 April 1918 (SING); Government Hill, *Mohd Haniff 3497,* 1 October 1918 (SING,K) – **PERAK.** Perak, *Scortechini, B. s.n.* (SING); Gopeng, *King's collector*

8191, September 1885 (SING) – **PERLIS.** Taman Herba, Batu Pahat, *Zainudin, A. AZ 6906,* 30 July 2000 (UKMB); Kangar, *Zainudin, A. AZ 3820,* 22 Aug 1991 (L,UKMB) – S**ELANGOR.** Kuala Pansom, *Gadoh, U. KL 1789,* 22 Sep 1959 (KEP,L,K,SING).

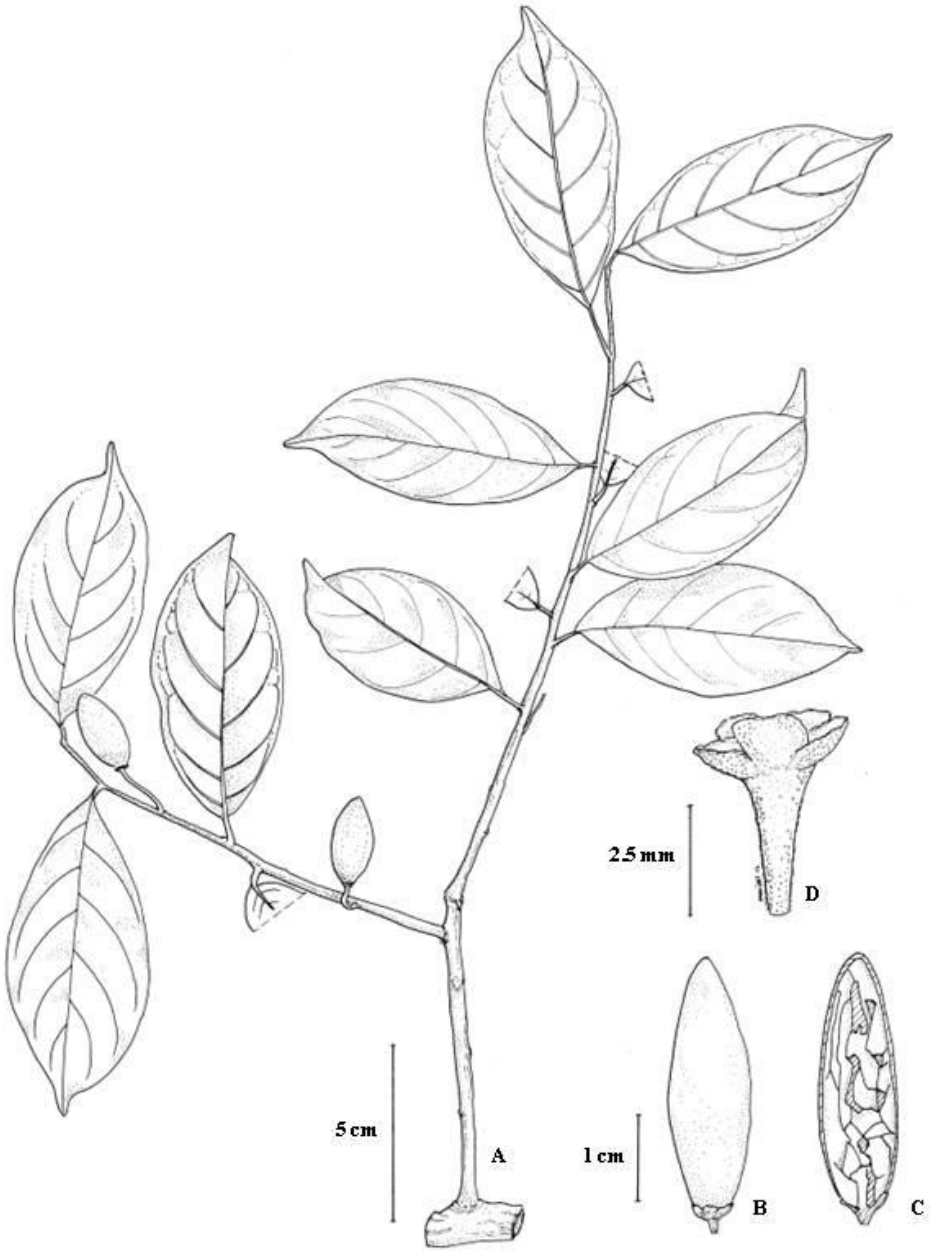

Fig. 4.4. Illustration of *Erycibe griffithii* C.B. Clarke. A, infructescence twig; B, fruit; C, longitudinal section of fruit (folded cotyledon); D, calyx (A–D from *AZ 3820*).

4.3.2.7 *Erycibe leucoxyloides* King *ex* Prain **Fig. 4.5**

(Latin, *leuco* = white, *xyloides* = wood; referring to the wood colour)

J. As. Soc. Beng. 73, 2 (1903) 16, J. As. Soc. Beng. 74, 2 (1906) 292; Ridley, Fl. Malay Pen. 2 (1923) 446; Henderson, Gard. Bull. S. S. 4 (1927) 100, Gard. Bull. S. S. 4 (1928) 292; Hoogland *in* Ooststroom, Fl. Malesiana 4 (1953) 416; Hoogland, Blumea 7 (1953) 350; Ng, Tr. Fl. Malaya 4 (1989) 74. **Type:** *Ridley 6897*, Singapore, Bukit Timah (lectotype CAL, isolectotype BM!, K!, SING!); *Curtis 2402*, Peninsular Malaysia, Kuala Lumpur (syntypes BM, K, SING!); *Hallier s.n.*, (syntypes G, L); *Ridley 2051* (syntype *n.v.*); *Ridley 10927* (syntype *n.v.*).

A slender low bushy climber. **Twigs** very slender; young branches densely stellate-hirsute, older longitudinally ridged. **Leaves:** petioles terete, 1–2 mm long, 1–2 mm thick, densely stellate-hirsute; laminas elliptic to oval-elliptic, 1.1–5.5 × 0.5–2 cm, chartaceous, glabrous on both surfaces with sparse black dots, base obtuse, margin flat, apex acute to obtuse tip; midrib sunken above, glabrous, prominent beneath, glabrous; lateral veins usually inconspicuous both sides, rarely conspicuous 3–5 pairs; intercostal veins inconspicuous both sides. **Inflorescences** axillary**;** pedicels 3–4 mm long, densely stellate-hairy; bracteoles elliptic, 2–2.5 × 1–1.5 mm, densely stellate-hairy outside, sparsely stellate-hairy inside. **Flowers** solitary**;** buds to 1.5–2 mm diameter, densely stellate-hirsute; two outer sepals orbicular, 2–2.5 × 2–2.5 mm, three inner sepal transverse-oval, 2–2.3 × 2.5–3 mm, stellate-hirsute outside at the centre part, hairs stalked, 4–6-unequal branched, with one longer, to 380 μm long, almost glabrous near margin, longitudinal veins conspicuous; corolla white, *c*. 6 mm long, *c*. 5 mm across, tube 3 *c*. mm long; midpetaline bands 4–6 × 2–2.3 mm, thickened fleshy, densely stellate appressed-hairy, hairs stalked, 3–5-unequal

branched, with one longer, to 943 μm long; corolla lobes *c.* 4 mm long, *c.* 5 mm across; lobules coherent just above the midpetaline bands, oblong, *c.* 3.5 × 2.5 mm, margin entire, longitudinal venation conspicuous; stamens inserted *c.* 0.3 mm above corolla base; filaments 0.7 mm long, broader at the base; anthers *c.* 1.2 mm long, 0.5 mm thick, base almost cordate, apex acuminate; ovary *c.* 0.9 × 0.7 mm, glabrous; stigma 5-ridged. **Fruits:** pedicel *slender*, 3–4 mm long, *c.* 1 mm thick, densely stellate-hirsute; ellipsoid, 0.7–0.9 × 0.4–0.6 cm, base acute, apex obtuse; exocarp glabrous, smooth, immature green, ripening unknown; mesocarp unknown. **Seed** ellipsoid, 5–7 × 2–3 cm; cotyledon flat.

Distribution: Peninsular Malaysia and Singapore. In Peninsular Malaysia, recorded in Selangor and Johor.

Conservation status. Near Threatened (NT).

Ecology: Found near roadside and open area (*Z. Teruya, 1172*) and near cave area in Kuala Lumpur (*C. Curtis, 2408*). Flowering in February and December, and fruiting in February. The flower is sweet scented.

Uses. Not recorded.

Notes and discussion.

1. Among *Erycibe* species, *E. leucoxyloides* is easily recognized by its small lamina which is less than 5.5 cm long and 2 cm wide and always has inconspicuous or sometimes faint and a few secondary veins (3 to 5 pairs).
2. The flowers are born solitary which is very distinct from other species.

Specimens examined. JOHOR. Johor Bahru, *Nong Chie 21*, 14 December 1891 (SING); Mawai road, 2 mile, *Teruya, Z. 1172*, 10 February 1930 (SING) – **KUALA LUMPUR.** Kuala Lumpur, *Curtis, C. 2402*, February 1890 (SING) – **SELANGOR.** Batu Caves, *Curtis, C. 2408*, February 1890 (SING).

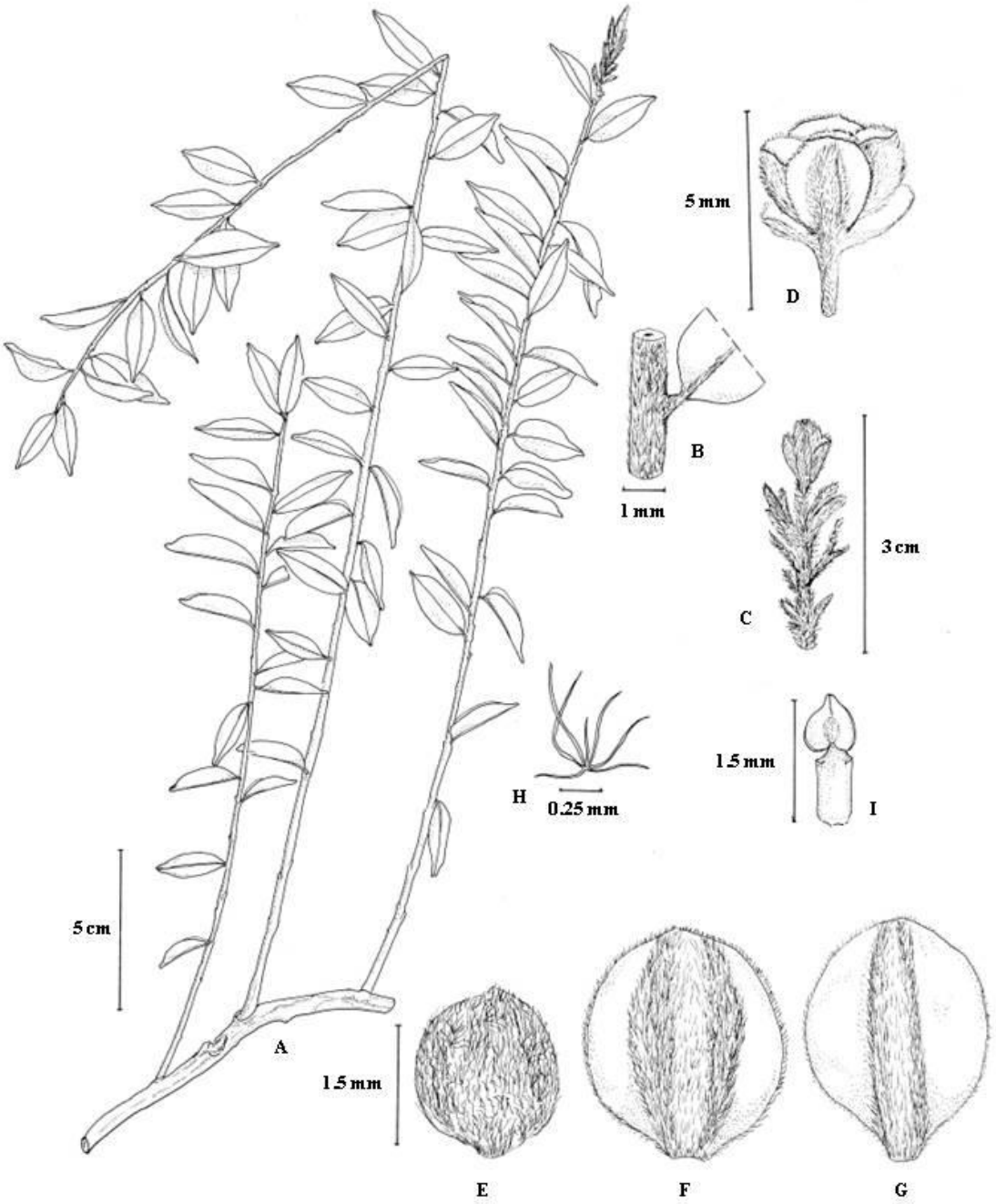

Fig. 4.5. Illustration of *Erycibe lecoxyloides* King *ex* Prain. A, habit; B, twig; C, inflorescence; D, flower bud; E, outer sepal; F & G, inner sepals; H, hair from inner sepal; I, stamen (A–I from *1172*).

4.3.2.8 *Erycibe magnifica* Prain **Fig. 4.6**

(Latin, *magnificus* = splendid; referring to the big leaves)

J. As. Soc. Beng. 73, 2 (1903) 18; J. As. Soc. Beng. 74, 2, (1906) 289; Ridley, Fl. Malay Pen. 2 (1923) 445; Burkill & Henderson, Gard. Bull. S. S. 3, (1925) 400; Hoogland *in* Ooststroom, Fl. Malesiana 4 (1953) 412; Hoogland, Blumea 7 (1953) 351; Ng, Tr. Fl. Malaya 4 (1989) 75. **Type:** *Kunstler 3454*, Peninsular Malaysia, Perak, Larut (lectotype CAL, isolectotype K!); *Kunstler 3879*, Peninsular Malaysia, Perak, Larut (syntype K!, P, SING!); *Kunstler 6721*, Peninsular Malaysia, Perak, Larut (syntype K).

A strong woody climber, 12–15 m tall. **Twigs** terete; young branches densely stellate-hirsute, older glabrescent with faint and low longitudinal ridges. **Leaves:** petioles terete, 10–15 mm long, 4–7 mm thick, densely strigose-hairy; laminas elliptic to obovate, 8.5–18 × 5.2–8.7 cm, green and glossy above, light brown beneath, *thickly coriaceous*, almost glabrous above, *densely stellate-villous* beneath on midrib, lateral and intercostal veins, base obtuse, margin *strongly revolute* when dry, apex *obtuse*; midrib sunken above, prominent beneath; lateral veins sunken above, prominent beneath, (6–)10–13 pairs, ending close to margin; intercostal veins reticulate, inconspicuous above, conspicuous beneath. **Inflorescences** axillary, racemose, 2–4 together, to 4.5 cm long, (2–4)–13-flowered; pedicels 4–5 mm long, stellate-hirsute; bracteoles elliptic, *c.* 1.2 × 1 mm, densely stellate-hirsute both sides. **Flowers:** buds to 7 mm diameter, densely stellate-tomentose; two outer sepals orbicular, *c.* 5 × 5 mm, three inner sepals transverse-oval, *c.* 5 × 6 mm, densely stellate-hirsute outside, hairs 2–6-unequal branched, with one longer to 1500 μm long (from Hoogland in Ooststroom); corolla dark yellow, to *c.* 10 mm long, tube *c.* 4 mm long; midpetaline bands densely appressed-hairy, branching basally, hairs 1–4-unequal branched,

longest branches to 2000 μm long (from Hoogland in Ooststroom); corolla lobules *clavate*, *c.* 2.5 × 2 mm; stamens inserted *c*. 2.5 mm above the corolla base; filaments *c*. 0.5 mm long, broader at the base; anthers *c*. 0.8 mm long, *c*. 0.8 mm thick, base almost cordate, apex obtuse; ovary *c*. 1 × 1.5 mm, densely hirsute; stigma 5-ridged. **Fruit:** *pedicel thick* and *long*, 9–10 mm long, 3–5 mm thick, densely stellate-hirsute; flattened-ellipsoid, 2.9 × 2.3 cm; obtuse at both ends; exocarp densely long strigose hairy, immature and ripening unknown; mesocarp unknown. **Seed:** cotyledon flat.

Distribution. Endemic to Peninsular Malaysia, recorded only in Perak (Larut and Larut Matang).

Conservation status. Near Threatened (NT).

Ecology. In open or dense forest to 30–300 m altitude. Flowering in October and fruiting in February.

Uses. Not recorded.

Notes and discussion.

1. This species is very rare and known only from two collections. From the specimen's label: *King's collector*, *3879*, the leaves are a fine deep green of a glossy appearance and light brown underneath.
2. The leaves are very thick coriaceous and have dense hairs on the lamina beneath.
3. The fruits are very distinct with other *Erycibe* species, covered with dense stellate-hirsute hairs.

4. The measurements of flower parts, including trichomes, are based on Hoogland's (in Ooststroom, 1953a) account.

Specimens examined. PERAK. Larut, *King's collector 3454*, 1882 (SING); Larut & Matang, *King's collector 3879* (K).

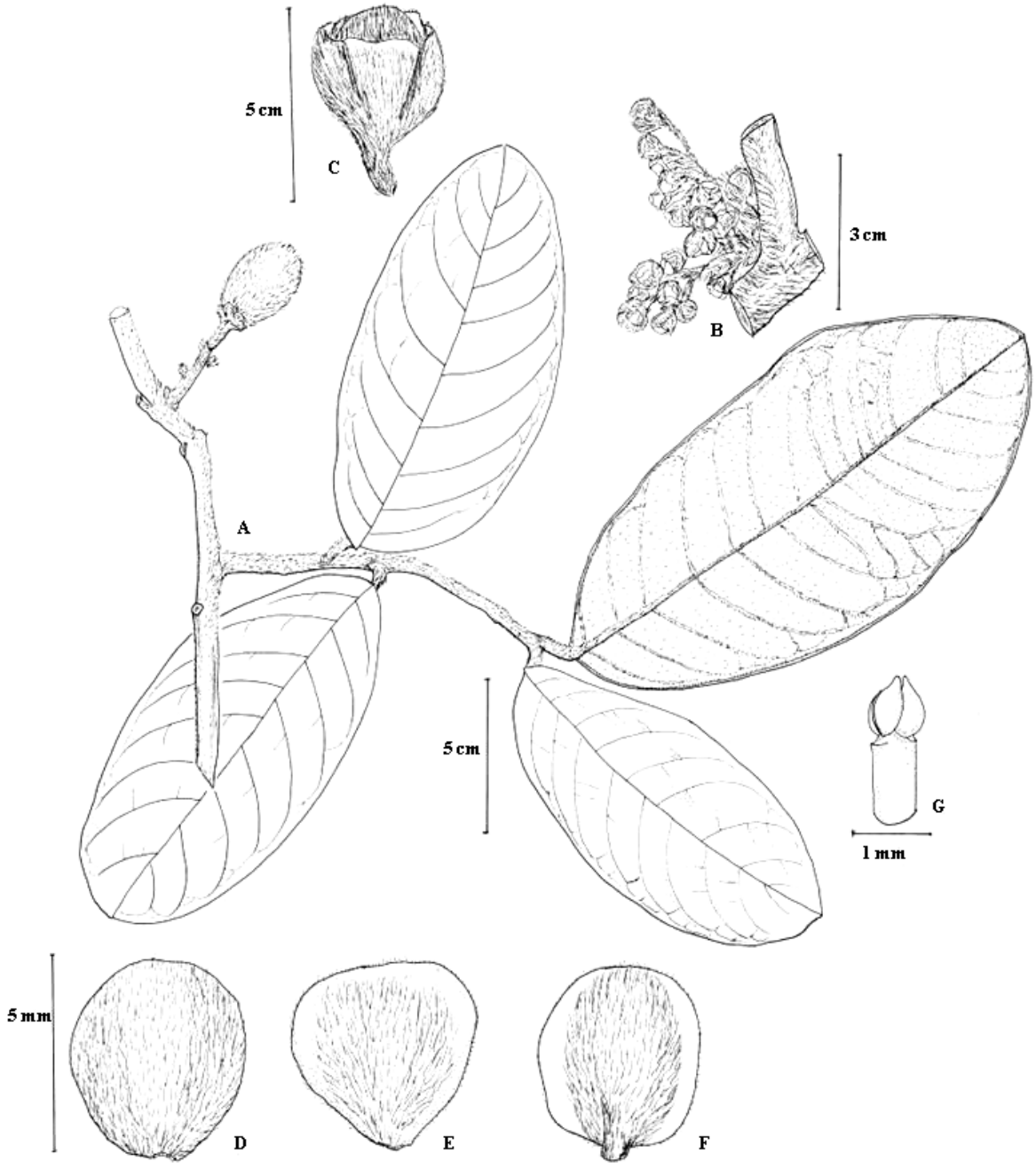

Fig. 4.5. Illustration of *Erycibe magnifica* Prain. A, habit; B, inflorescence twig; C, flower bud; D, outer sepal; E & F, inner sepal; G, stamen (A–G from *3879).*

4.3.2.9 *Erycibe maingayi* C.B. Clarke **Fig. 4.7**

(Alexander Carroll Maingay, 1836–1869, magistrate in charged of the jail at Melaka).

Fl. Brit. India 4 (1883) 182; Hallier *f*., Bull. Herb. Boissier 5 (1897) 1052; Hoogland *in* Ooststroom, Fl. Malesiana 4 (1953) 417; Hoogland, Blumea 7 (1953) 351; Ng, Tr. Fl. Malaya 4 (1989) 76. **Type:** *Maingay 1718* (= Kew Distr. No. 1156), Peninsular Malaysia, Melaka (lectotype K; isolectotype K!). **Misapplied name**: *Erycibe griffithii* Auct. *non* Clarke, Fl. Brit. India 4 (1883) 182; Prain, J. As. Soc. Beng. 74, 2 (1906) 295; Ridley, Fl. Malay Pen. 2 (1923) 447.

Climber or treelet to 10 m tall, stem 7.5 cm diameter. **Twigs** terete; young branches strigose, older glabrescent with longitudinal ridges; outer bark grayish. **Leaves:** petioles terete, 8–15 mm long, 1–1.2 mm thick, glabrous; laminas elliptic-oblong, 6–15 × 4.5–5.5 cm, thinly coriaceous to coriaceous, glabrous on both surfaces, dry leaves always *dark brown or maroon*, base cuneate, margin flat, apex shortly acuminate or acute; midrib sunken above, glabrous, prominent beneath, glabrous; lateral veins faintly prominent both sides, 4–9 pairs, ending close to margin; intercostal veins reticulate, faintly prominent both surfaces. **Inflorescences** axillary, racemose, to 2 cm long, (1–)2–14-flowered; pedicels 1–5 mm long, densely stellate-hairy; bracteoles linear to ovate, 1–1.2 × 0.7–1.2 mm, densely stellate-hairy on both sides. **Flowers:** buds to 3 mm diameter, densely stellate-hairy; two outer sepals orbicular, 2.5–3 × 2.5–3 mm, three inner sepals transverse-oval, 2.3–2.8 × 2.5–3 mm, densely hairy outside, hairs stalked, 2-subequal branched, branches to 300 μm long, longitudinal veins inconspicuous; corolla creamy, 8–9 mm long, 5–6 mm across, tube 2.5–3 mm long; midpetaline bands 2.7–3.5 × 1.7–2 mm, thickened fleshy, densely hairy, hairs

stalked, 2–(3–4)-unequal branched, longest branches to 685 μm long; corolla lobes 4–4.5 mm long, 3–3.5 mm across; lobules coherent above the midpetaline bands at *c*. 2 mm, oblong, 1–1.5 × 2–2.5 mm, margin entire, inconspicuous or faintly conspicuous; stamens attached at the corolla base or inserted *c.* 0.5 mm above the corolla base; filaments 0.6–0.9 mm long, broader at the base; anthers 1.1–1.3 mm long, 0.5–0.7 mm thick, base cordate, apex acuminate; ovary 0.7–1.1 × 0.8–1.1 mm, glabrous; stigma 5-ridged. **Fruits:** pedicel 3–4 mm long, *c.* 1 mm thick, sparsely strigose; ellipsoid, 1–1.2 × 0.6–0.7 cm, obtuse at both ends; exocarp coriaceous, smooth, glabrous, immature and ripening colour unknown; mesocarp fleshy. **Seed:** cotyledons flat.

Distribution. Peninsular Malaysia, Borneo and Sumatra. In Peninsular Malaysia, known from Negeri Sembilan, Melaka and Johor.

Conservation status. Least Concern (LC).

Ecology. Found in lowland forest at 80–120 m altitude and in swampy forest. Flowering in July, August and fruiting in February and May.

Uses. Not recorded.

Notes and discussion.

1. Prain (1906) and Ridley (1923) reduced the species to *Erycibe griffithii* Clarke. From my observations, the most remarkable characters between these two species are the dry leaves of *E. maingayi* are always dark brown or maroon on both surfaces compare to *E.*

griffithii which is dark brown or brown reddish at least upper surface and the size and shape of the fruit is smaller than *E. griffithii*.

Specimens examined. JOHOR. Sedili Kechil, *Rahim FMS 5836,* 15 Jul 1921 (KEP,SING); Sg. Kayu, *Corner, E.J.H. SFN 21332,* 3 Feb 1935 (KEP,K,SING); Sg. Kayu Ara, *Corner, E.J.H. SFN 29334,* 11 May 1935 (KEP,SING) – **MELAKA.** Malacca, *Maingay, A.C. 1718* (K) – **NEGERI SEMBILAN.** Pasoh F.R., *Gardette, E. EG 1709,* 25 Apr 1996 (KEP,SING); *Gardette, E. EG 1799,* 8 May 1996 (KEP,SING); *Gardette, E. EG 1880* 23 May 1996 (KEP,SING); *Gardette, E. EG 1964,* 9 Jun 1996 (KEP).

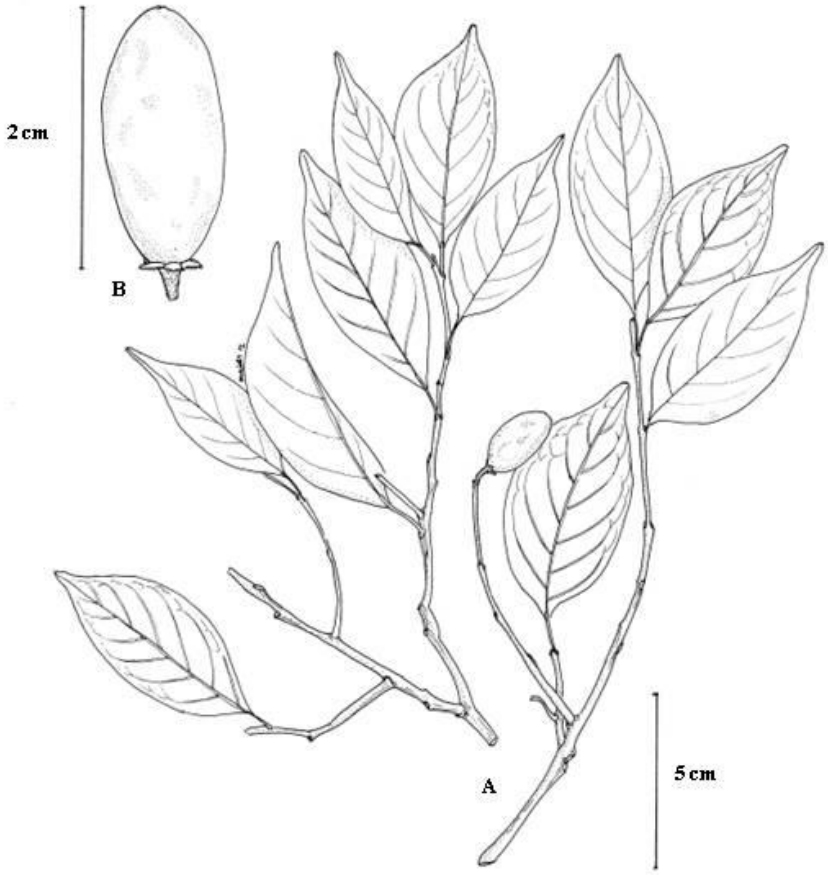

Fig. 4.7. Illustration of *Erycibe maingayi* C.B. Clarke. A, habit; B, fruit (A–B from *SFN 29334*).

4.3.2.10 *Erycibe malaccensis* C.B. Clarke **Fig. 4.8**

(from Melaka)

Fl. Brit. India 4 (1883) 182; Prain, J. As. Soc. Beng. 63, 2 (1894) 85, J. As. Soc. Beng. 74, 2 (1906) 291; Ridley, Fl. Malay Pen. 2 (1923) 446; Burkill & Henderson, Gard. Bull. S. S. 3 (1925) 400; Burkill, Econ. Prod. Malay Pen. 1 (1966) 959; Hoogland *in* Ooststroom, Fl. Malesiana 4 (1953) 428; Hoogland, Blumea 7 (1953) 351; Ng, Tr. Fl. Malaya 4 (1989) 76. **Type:** *Maingay 2209* (= Kew Distr. No. 1154), Peninsular Malaysia, Penang, Government Hill (lectotype K!); *Griffith s.n.* (K barcode. no. K000545449, K000545450 & K000545451), Peninsular Malaysia, Malacca (syntype K!); *Maingayi 2205* (K barcode. no. K000545452), Peninsular Malaysia, Penang, Government Hill (syntype K!); *Maingay 2209A* (= Kew Distr. No. 1154), Peninsular Malaysia, Malacca (syntype K!); *Maingay* (L barcode no. L0795031) (syntype BM, L!).

Woody climber to 30 m tall, stem 12 cm diameter. **Twigs** angular; young branches stellate-hirsute, older glabrescent with longitudinal ridges. **Leaves:** petioles slender, terete, 4(–6) mm long, 1–1.5 mm thick, densely stellate-hirsute; laminas ovate or elliptic to oblong, (4.5–)5–9(–11) × (1.5–)2.3–3.6(–4.1) cm, coriaceous, almost glabrous on both surfaces, dry leaves always *pale brown or yellowish*, *glossy above*, base obtuse, margin flat, apex acuminate-obtuse; midrib prominent, glabrous both sides; lateral veins faintly prominent both sides, 4–8 pairs, lower pair sometimes *opposite*, ending curving close to margin and join with the next one to form a looped intramarginal vein; intercostal veins reticulate, *prominent* both sides. **Inflorescences** axillary, racemose, always 2–3 together, to 9 cm long, (1–)2–8(–30)-flowered; pedicels 4–6 mm long, stellate-hirsute; bracteoles elliptic-oval, 4–5 × 1.5–2 mm, densely stellate-hirsute both sides. **Flowers:** buds to 3 mm diameter,

densely stellate-hirsute; two outer sepals orbicular to transverse-oval, 3.3–4 × 3.3–5 mm, three inner sepals transverse-oval, 2.5–3 × 3–4 mm, densely stellate-hirsute outside, hairs nearly sessile, (3–)4–8-subequal branched, branches to 350 μm long, longitudinal veins conspicuous; corolla white, 7–11 mm long, *c*. 10 mm across, tube 2–4 mm long; midpetaline bands 3–3.5 × 2–2.5 mm, fleshy, densely appressed-hairy, hairs nearly sessile, (2–)3–5(–7)-unequal branched, longest branches to 750 μm long; corolla lobes 3.5–4.5 mm long, 4–6 mm across; lobules coherent above the midpetaline bands at *c*.1.5 mm, oblong, 2.5–4.5 × 3.5–5.5 mm, margin entire, longitudinal venation conspicuous; stamens inserted 0.8–1.5 mm above the corolla base; filaments 0.8–1.5 mm long, broader at the base; anthers 1.3–1.7 mm long, 0.4–0.8 mm thick, base broadly cordate, apex acuminate; ovary 0.7–1.5 × 1.2–1.7 mm, glabrous; stigma 5-ridged. **Fruits:** pedicel 2–4 mm long, 1–2 mm thick, densely short stellate-hirsute; ellipsoid, 0.9–1.5 × 0.5–1.3 cm, obtuse at both ends; exocarp probably coriaceous, glabrous, smooth, immature bluish-green, ripening reddish-orange; mesocarp fleshy **Seed:** cotyledon flat.

Vernacular name. *Akar perut kijang jantan* (Malay), *Akar sekijang* (Malay), *Akar serawan jantan* (Malay).

Distribution. Peninsular Myanmar, Philippines, Celebes and Peninsular Malaysia. In Peninsular Malaysia, known from Kedah, Penang, Perak, Kelantan, Pahang, Negeri Sembilan, Melaka and Johor.

Conservation status. Least Concern (LC).

Ecology. Found in primary forest at 80–1200 m altitude, on ridges, near waterfalls, along roadsides and in open forest. Flowering in February, March, July and fruiting in February, May, June, August, September, October and November.

Uses. The poultices of the leaves may be applied to sores, and to the head for head-ache (Burkill, 1966).

Notes and discussion.

1. The species is strongly characterized by the glossy, pale brown or yellowish dry leaves and conspicuous intercostal veins on both surfaces of the leaves.

Specimens examined. JOHOR. Nam Heng, *Teruya, Z. 170,* 28 February 1926 (SING,L) – **KEDAH.** P. Chupa, *Corner, E.J.H. s.n.,* 19 November 1941 (SING) – **KELANTAN.** Gua Musang, *Latiff, A. ALM 1081,* 12 Oct 1985 (UKMB,L); Sg. Brok, *Ng, F.S.P. FRI 5427,* 13 June 1967 (L); *Ng, F.S.P. FRI 5451,* 14 June 1967 (L) – **MELAKA.** Bkt. Sebukor, *Ridley, H.N. 3526,* 30 May 1892 (SING); Malacca, *Maingay, A.C. 1154* (K,L); *Alvins, M.V. 1456* (SING); *Alvins, M.V. 30* (SING); *Alvins, M.V. 650* (SING) – **NEGERI SEMBILAN.** Pasoh F.R., *Gardette, E. EG 1566,* 9 Feb 1996 (KEP,L,SING); *Gardette, E. EG 1591,* 29 Feb 1996 (KEP,L,SING); *Gardette, E. EG 1703,* 25 Apr 1996 (KEP,L,SING); *Gardette, E. EG 1778,* 7 May 1996 (KEP,L); *Gardette, E. EG 1820,* 9 May 1996 (KEP,L,KEP,L,SING); *Gardette, E. EG 1895* (L); *Gardette, E. EG 2193,* 4 Sep 1996 (KEP,L,SING); *LaFrankie, J.V. 6029,* 1989 (KEP); Serting F.R., *Gardette, E. EG 2121,* 20 Aug 1996 (KEP,L,SING) – **PAHANG.** Fraser's Hill, *Mohd Nur 11324,* 11 September 1923 (SING) – **PENANG.** Waterfall Garden, *Curtis, C. 3600,* March 1901 (SING,K) – **PERAK.** Perak, *Wray, L.*

2412, July 1888 (SING,L); Larut, *King's collector 3180*, August 1882 (SING); *King's collector 3575*, November 1882 (SING).

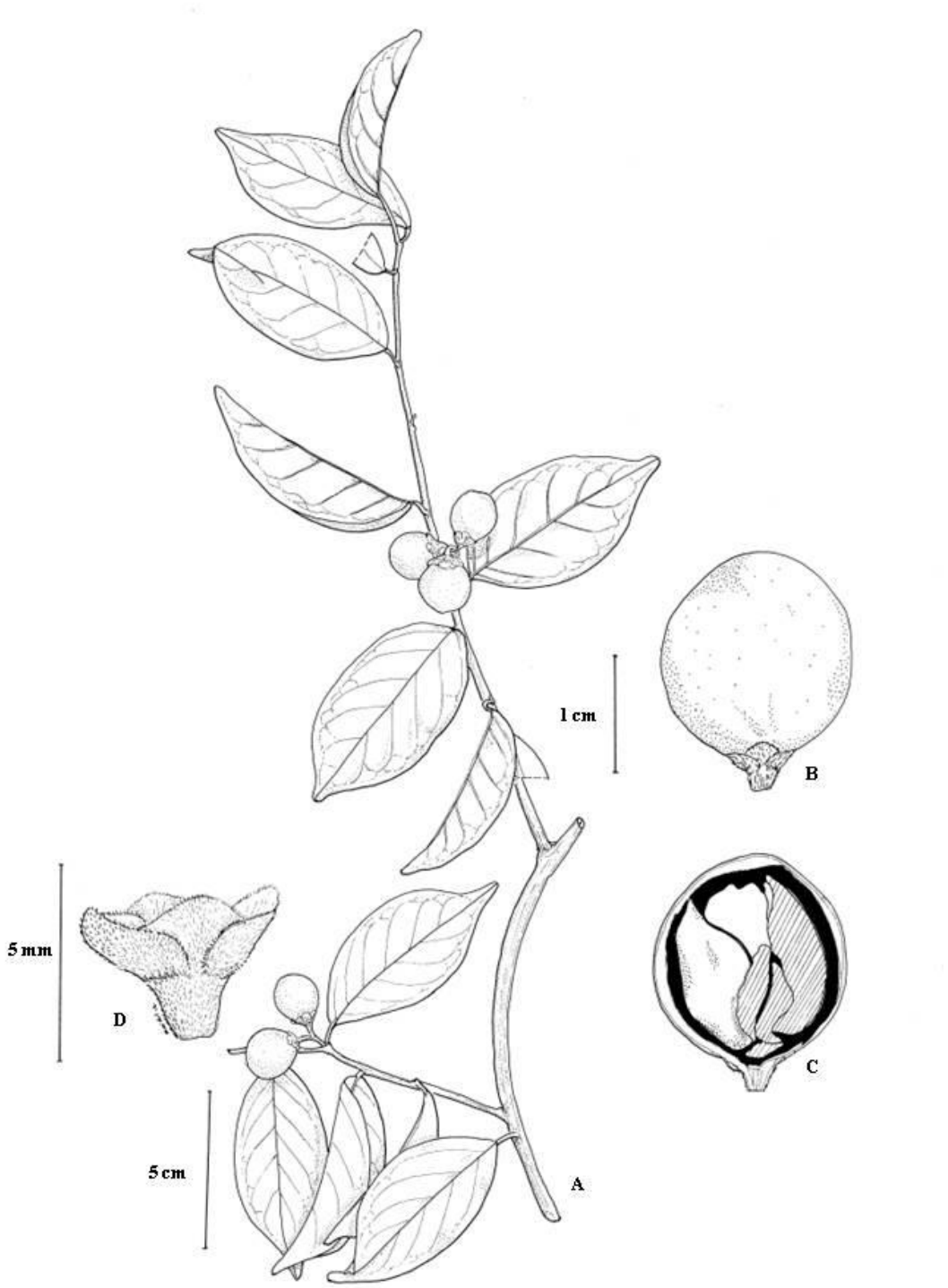

Fig. 4.8. Illustration of *Erycibe malaccensis* C.B. Clarke. A, habit; B, fruit; C, longitudinal section of fruit (flat cotyledon); D, calyx (A–D from *ALM1081*).

4.3.2.11 *Erycibe praecipua* Prain ssp. *praecipua* **Fig. 4.9**

(Latin,) *praecipue*, an adverb meaning "principally, especially, mainly".

J. As. Soc. Beng. 63, 2 (1894) 86, J. As. Soc. Beng. 74, 2 (1906) 294; Ridley, Fl. Malay Pen. 2 (1923) 447; Burkill & Henderson, Gard. Bull. S. S. 3 (1925) 400; Hoogland *in* Ooststroom, Fl. Malesiana 4 (1953) 409, fig. 12a–b; Hoogland, Blumea 7 (1953) 354; Ng, Tr. Fl. Malaya 4 (1989) 76. **Type:** *Curtis 911* (July 1886), Peninsular Malaysia, Penang (lectotype CAL; isolectotypes K!, L! [photo!], SING!; *Curtis 911* (1890), Peninsular Malaysia, Penang, Government Hill (syntype E [photo!]); *Curtis 1273*, Peninsular Malaysia, Penang, Government Hill (syntypes K!, SING!).

Climber or scandent shrub. **Twigs** terete; young branches sparsely hairy, older longitudinally ridged. **Leaves:** petioles terete, 5–10 mm long, 1–1.5 mm thick, channeled above at base, conspicuous *ring-like* at base, glabrous; laminas elliptic-oblong, 5.3–10.5 × 2.3–4.1 cm, *thickly* coriaceous, glabrous on both sides, dry leaves *glossy yellowish brown*, base obtuse, margin flat, apex acuminate; midrib prominent, rarely sunken above, glabrous, prominent beneath, glabrous; lateral veins faintly prominent above, prominent beneath, 3–5 pairs, ending close to margin; intercostal veins reticulate, *sunken* or sometimes inconspicuous both sides. **Inflorescences** axillary, racemose, to 1.8 cm long, (1–)2–9-flowered; pedicels 2–5 mm long, sparsely strigose; bracteoles linear, *c*. 1 x 0.5 mm, sparsely stellate-hairy both sides. **Flowers:** buds to 3 mm diameter, densely stellate-hairy; all sepals *almost equal*, broadly ovate or orbicular to transverse-oval, 1.8–2 × 1.8–2.5 mm, sparsely strigose outside, hairs nearly sessile, 2-subequal branched, branches to 200 μm long, longitudinal veins inconspicuous; corolla yellowish, *c*. 7 mm long, *c*. 8 mm across, tube 1.7–2 mm long; midpetaline bands 3.5–3.8 × 1.6–2.2 mm, fleshy, densely stellate-

hirsute *both inside and outside surface*, hairs nearly sessile, 2–4-subequal branched, branches to 223 μm long; corolla lobes *c*. 4 mm long, *c*. 2.5 mm across; lobules coherent above the midpetaline bands at *c*.1.5 mm, oblong, *c*. 1.8 × 1.5 mm, margin entire, longitudinal venation faintly conspicuous; stamens inserted 0.6–1.2 mm above the corolla base; filaments 0.2–0.4 mm long, broader at the base; anthers *c.* 0.7 mm long, 0.4–0.5 mm thick, *truncate* at both ends; ovary 1–1.2 × 0.9–1.2 mm, glabrous; stigma 5–10-ridged. **Fruits:** pedicel 1–1.7 mm long, *c.* 1 mm thick, glabrous; ellipsoid, 1–1.8 × 0.8–1.2 cm, tapering at both ends; exocarp *coriaceous, glabrous*, smooth, immature unknown, ripening dull orange; mesocarp fleshy. **Seed**: cotyledons *strongly folded*.

Distribution. Endemic in Peninsular Malaysia, known from Penang (Government Hill), Perak and Johor.

Conservation status. Vulnerable (VU).

Ecology. Found at lowland and hillsides from 150–600 m altitude. Flowering in February, July, and fruiting in April, May and October.

Uses. Not recorded.

Notes and discussion.

1. Prain, in naming this species, pointed out the principal, or main difference between this species and other *Erycibe* species in the Peninsular Malaysia: is the hairy inner and outer surface of corolla.

2. *Erycibe praecipua* ssp. *borneensis* Hoogl. differs from ssp. *praecipua* by having larger leaves, more lateral veins and longer petiole, inflorescence and pedicel. It was collected once from Kinabalu (Borneo) at 1200 m altitude.

Specimens examined. JOHOR. Mawai, *Corner, E.J.H. 28441*, 21 May 1934 (SING) – **PENANG.** Government Hill, *Curtis, C. 911*, July 1886 (SING, L,K); *Curtis, C. 1273*, April 1890 (SING, K) – **PERAK.** Kledang Saiong F.R., *Tachun FMS 33618*, 6 Feb 1934 (KEP,SING).

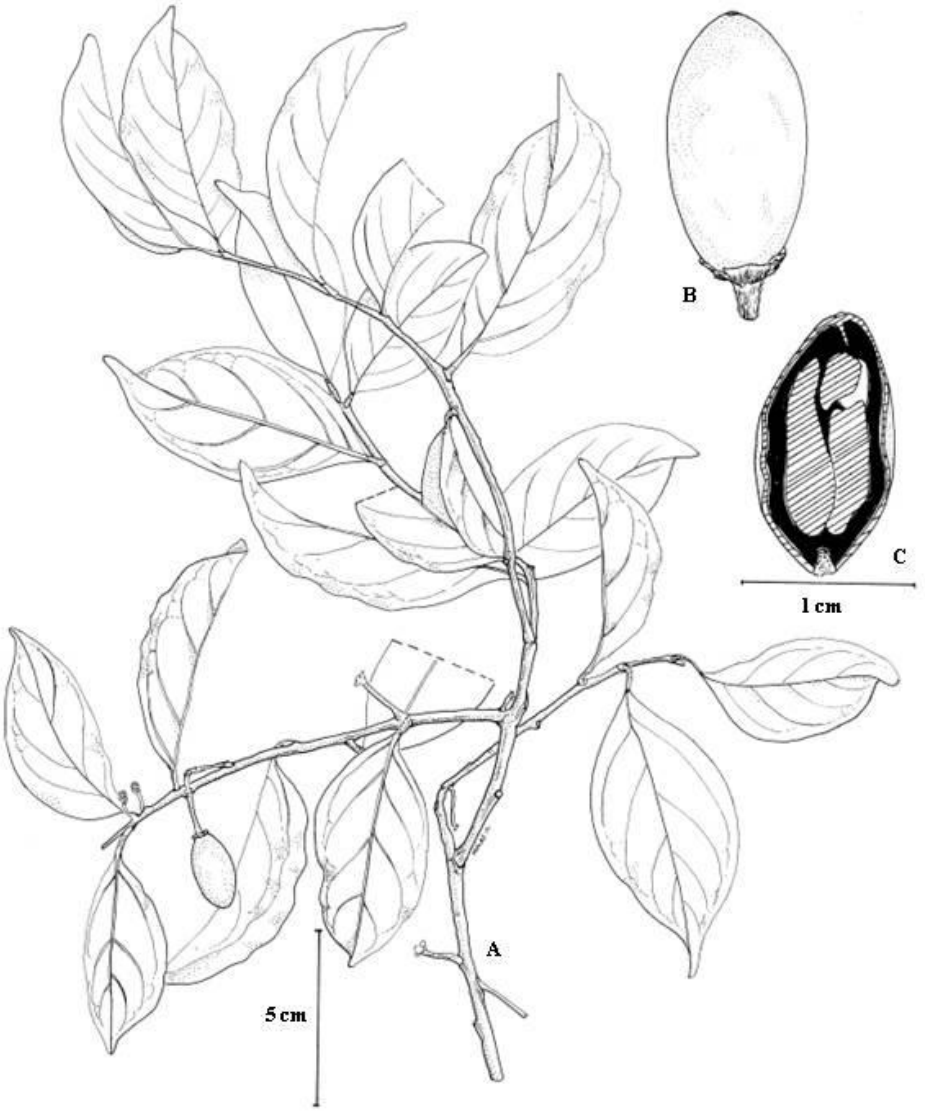

Fig. 4.9. Illustration of *Erycibe praecipua* Prain *ssp. praecipua*. A, habit; B, fruit; C, longitudinal section of fruit (folded cotyledon) (A–C from *1273*).

4.3.2.12 *Erycibe rheedii* Blume **Fig. 4.10**

(H.A. von Rheede tot Draakestein, 1637–1691, a botanist who wrote the book, *Hortus Malabaricus*, cited in the protologue for *E. rheedii*)

Bijdr. Fl. Ned. Ind. 16 (1826) 1047; Don, Gen. Hist. Dichl. Pl. 4 (1838) 392; Van Ooststroom *in* Backer, Bekn. Fl. Java 8 (1949) fam. 191, 9; Hoogland *in* Ooststroom, Fl. Malesiana 4 (1953) 425; Hoogland, Blumea 7 (1953) 355; Ng, Tr. Fl. Malaya 4 (1989) 75. **Type:** *Blume 64*8, Java, Mount Salak (L, barcode no. L004155, L0004156, L0004157 & L0004158) (lectotype L!). **Synonyms:** *E. angulata* Prain, J. As. Soc. Beng. 63, 2 (1894) 84, J. As. Soc. Beng. 74, 2 (1906) 291; Ridley, Fl. Malay Pen. 2 (1923) 448; Henderson, Gard. Bull. S. S. 4 (1927) 292; Burkill, Econ. Prod. Malay Pen. 1 (1966) 959. **Type:** *Kunstler 7379*, Peninsular Malaysia, Perak, near Gunung Bubu (lectotype CAL; syntypes B, BM, G, K!, L!, P, SING!); *Kurz s.n.*, Java (syntype *n.v.*); *Scortechini 1816*, Peninsular Malaysia, Perak, Dijong (syntypes K, SING!); *Teysmann HB 3682*, Sumatra (syntypes BO, U).

Small to large scandent climber, creeper or woody climber to 20 m tall. **Bole** crooked**. Twigs** terete**;** young branches densely reddish to dark brown strigose-hairy, older glabrescent, smooth or a few orbicular lenticels; inner bark creamy. **Leaves:** petioles terete, 5–8 mm long, 1–2 mm thick, channelled above at base, glabrous; lamina elliptic-oblong to oblong, 3.5–22(–24) × 5–9(–11) cm, coriaceous, glabrous both sides, dry leaves dull or dark brown, base obtuse to cuneate, margin flat, apex shortly acuminate to acuminate or obtuse; midrib glabrous, faintly sunken above, sparsely stellate-hirsute soon glabrescent, faintly prominent beneath; lateral veins prominent both sides, (5–)8–11 pairs, curving and ending close to margin; intercostal veins reticulate, prominent both sides. **Inflorescences** terminal and axillary, paniculate, 1–3 together, *always with some leaves in basal part*,

downward passing into axillary, to 15 cm long, 4–50-flowered; pedicels 1–3 mm long, densely stellate-hairy; bracteoles ovate to oblong, *c.* 1.5–2 × 0.5 mm, densely stellate-hairy both sides. **Flowers:** buds to 2 mm diameter, densely stellate-hairy; two outer sepals broadly ovate to orbicular or transverse oval, 2.5–3 × 2.5–3 mm, three inner sepals transverse-oval, 2–2.5 × 2.8–3.2 mm, stellate-hirsute outside, hairs stalked, 5–6-unequal branched, with one longer to 380 μm long, longitudinal veins conspicuous; corolla white, creamy or light yellow, 7–9 mm long, 8–9 mm across, tube 2.5–3 mm long; midpetaline bands, 3–4 × 1.8–2.8 mm, densely stellate-hairy, hairs stalked, 4–6-subequal branched, branches to 180 μm long; corolla lobes 5–6 mm long, 7.5–8.5 mm across; lobules thick fleshy, coherent above the midpetaline at *c.* 5 mm, oblong, 5–6 × 2.5–3.3 mm, margin entire, longitudinal venation inconspicuous; stamens inserted at the corolla base; filaments 2–2.5 mm long; anthers *c.* 1.5 mm long, 0.7–1 mm thick, base cordate, apex acuminate; ovary 1.3–1.5 × 1–1.2 mm, glabrous or glabrous at lower part, stellate-hirsute at upper part; stigma 10-ridged. **Fruits:** pedicel 5–8 mm long, *c.* 1 mm thick, densely stellate-hairy; ellipsoid, 1.9–2.1 × 1–1.2 cm, base obtuse, apex shortly acute; exocarp probably little fleshy, usually stellate-hairy near apex or rather glabrous, immature light green, ripening brownish to black; mesocarp unknown. **Seed:** cotyledons flat.

Vernacular name. *Tampang ari, tampang ular ari, rumput ular ari* (Malay).

Distribution. Peninsular Malaysia, North Borneo, Sumatra and West Java. In Peninsular Malaysia, recorded in Kedah, Perak, Selangor, Pahang, Melaka and Johor.

Ecology. In primary forest at lowland and young forest at 60 to 240 m altitude. Flowering in February, March, April, August, September, and October and fruiting in March and April. Flowers are sweetly fragrant.

Uses. The root (boiled with oil) is used medicinally by rubbing on the women's lower abdomen to expedite delivery (Burkill, 1966).

Notes and discussion.

1. The paniculate inflorescence reached up to 15 cm long, always with some leaves on basal part.
2. The fruit usually has stellate-hairy near apex or rather glabrous.
3. The leaves sometimes most likely to *E. festiva* which is dull or dark brown but *E. festiva* has racemose inflorescence while *E. rheedii* has paniculate inflorescence.

Specimens examined. JOHOR. Ayer Hitam, *Poore, M.E.D. 000295*, 9 Aug 1960 (KLU); Kuala Sembrong, *Lake s.n.* (SING); Labis F.R., Cpt. 280, *Ogata, K. KEP 110372*, 23 Mar 1968 (KEP,L,SING) – **KEDAH.** Alor Star, *Ridley, H.N. 15341*, February 1910 (SING,K); P. Dayang Bunting, *Chew, W.L. CWL 150*, 16 May 1957 (SING,L,KLU); P. Tuba, *Kamarul Hisham, M. FRI 52178*, 15 March 2007 (KEP,L,SING,K,SAN,A,SAR,QRS,BKF,BO); P. Tuba, *Syahida Emiza, S. FRI 66754B*, 23 May 2010 (KEP) – **MELAKA.** Malacca, *Alvins, M.V. 802*, 3 May 1885 (SING) – **PAHANG.** Cameron Highlands, G. Brinchang, *Poore, M.E.D. 295*, 6 Nov 1963 (K) – **PERAK.** Perak, *Scortechini, B. 1816* (SING); Changkat Jong F.R., *Ng, F.S.P. FRI 5624*, 9 Sep 1967 (KEP,K,L,SING); Larut, *King's collector 7379*, March 1885 (SING,K,L) –

SELANGOR. Batu Caves, *Burkill, I.H. 6365* (SING); Batu Tiga, *Ridley, H.N. 12051*, August 1909 (SING); Puchong, 17 mile, *T. & P. 2677*, 11 April 1968 (SING).

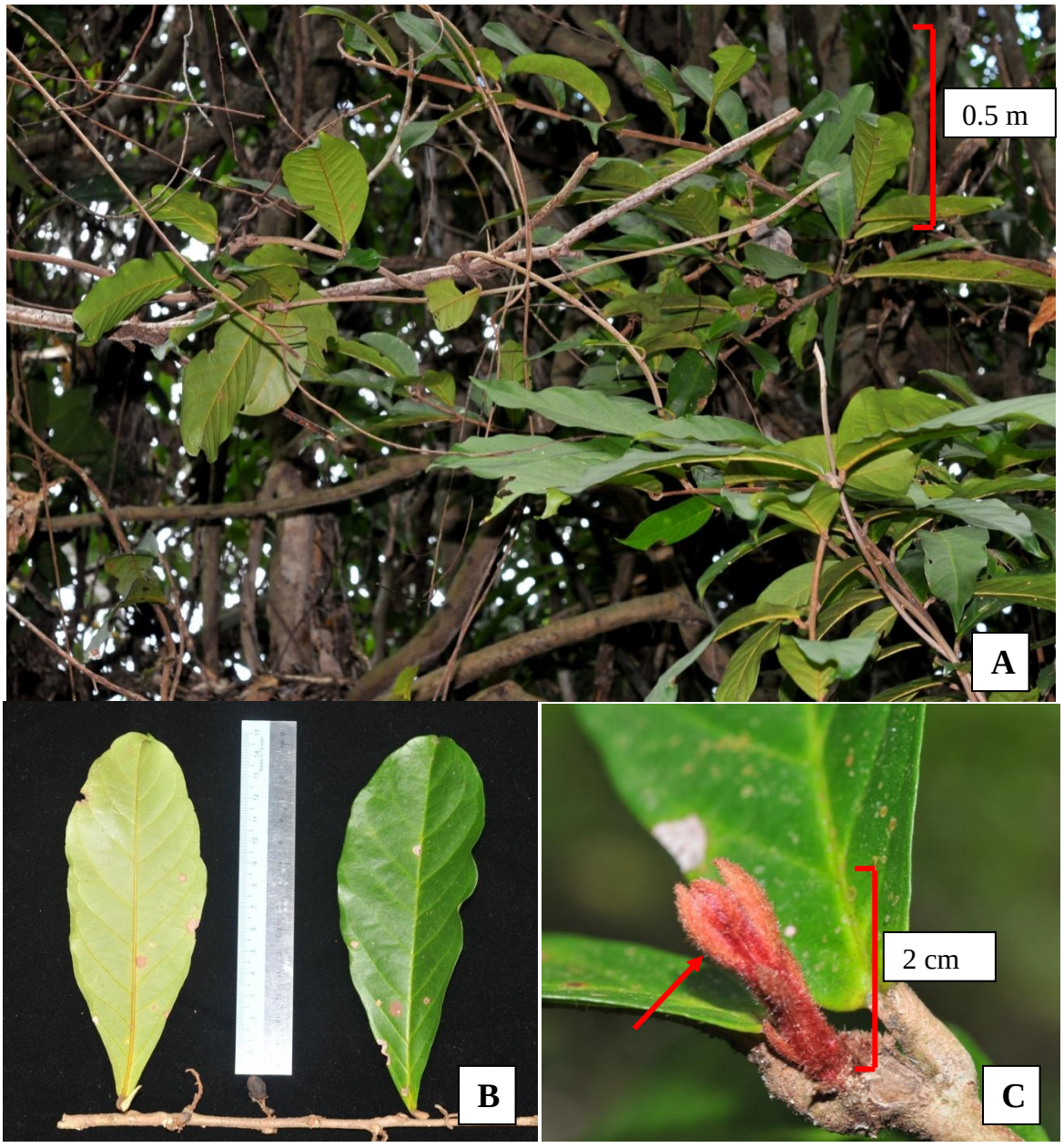

Fig. 4.10. *Erycibe rheedii* Blume. A, Habit; B, Abaxial (left) and adaxial (right) leaf surface; C, Young shoot that densely covered by reddish hairs.

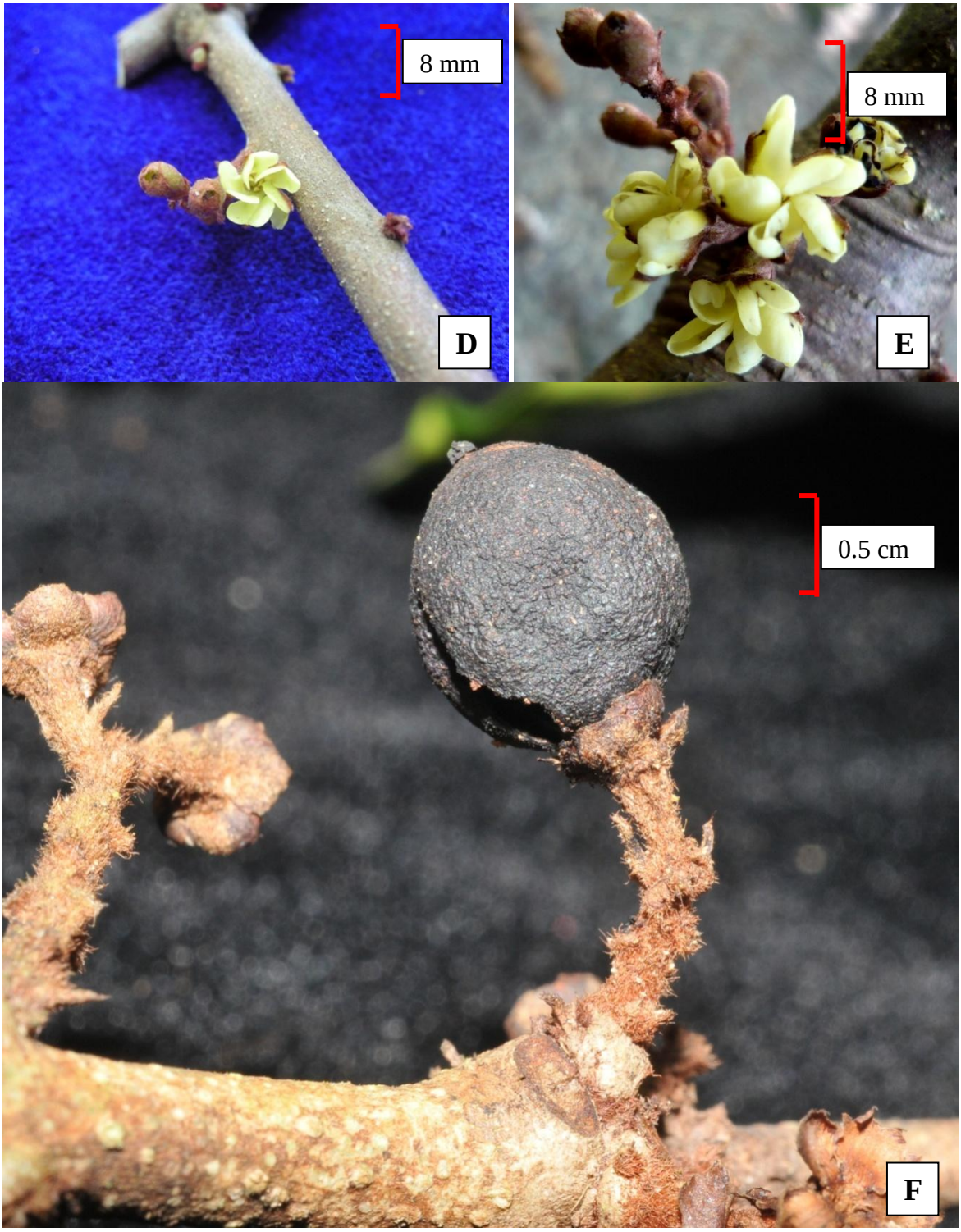

Fig. 4.10. (continued). *Erycibe rheedii* Blume. D–E, The inflorescence, flowers yellowish; F, The infructescence, ripe fruit.

4.3.2.13 *Erycibe sapotacea* Hallier *f*. & Prain **Fig. 4.11**

(Latin, *sapotacea* = referring to the fruits appearance like the fruits of species in the family Sapotaceae)

J. As. Soc. Beng. 73, 2 (1903) 16, J. As. Soc. Beng. 74, 2 (1906) 293; Ridley, Fl. Malay Pen. 2 (1923) 447; Hoogland *in* Ooststroom, Fl. Malesiana 4 (1953) 409, fig. 11; Hoogland, Blumea 7 (1953) 355; Ng, Tr. Fl. Malaya 4 (1989) 76. **Type:** *Curtis 772*, Peninsular Malaysia, Penang, Penang Hill (lectotype CAL; isolectotype CAL, K!, P, SING!).

Woody climber to 15 m tall, stem 3–4 cm diameter. **Twigs** *angular*; young branches with a few lenticels or glabrous, older dark brown with conspicuous longitudinal ridges; inner bark creamy. **Leaves:** petioles terete, slender, 10–15 mm long, 8–12(–16) mm thick, *channelled* above at base, glabrous; laminas elliptic-oblong, 11.2–19.6 × 4.8–8.8 cm, thickly coriaceous, glabrous on both surfaces, dry leaves always *glossy greenish above*, *dull green beneath*, base obtuse to cuneate, margin flat, apex shortly acuminate or rarely acute; midrib almost sunken, glabrous above, prominent, glabrous beneath; lateral veins prominent both surfaces, 5–8 pairs, ending close to margin; intercostal veins reticulate, *prominent both surfaces*. **Inflorescences** axillary, racemose, to 1.2 cm, 2–4(–5)-flowered; pedicels 1–2 mm long, densely stellate-hairy; bracteoles elliptic, *c.* 1.5 × 0.5 mm, densely stellate-hairy outside, sparsely stellate-hairy inside. **Flowers** known only from buds; buds to 2 mm diameter, densely stellate-hairy; two outer sepals broad-ovate, *c.* 2.7 × 3 mm, three inner sepals transverse-oval, 2.5× 3.2 mm, densely strigose-hairy outside, hairs 2-branched, longest branches to 400 μm long (from Hoogland in Ooststroom); corolla *c*. 7.5 mm long, tube *c*. 2.5 mm long; midpetaline bands *c*. 3.5 x 2 mm, thickened fleshy, densely hirsute,

hairs (2–)3(–5)-branched, longest branches to 500 μm long (from Hoogland in Ooststroom); corolla lobes 5 mm long, 2 mm across; lobules coherent just above the midpetaline bands, oblong, *c*. 2.5 × 2 mm, rather thick, margin entire or more or less sinuate, longitudinal venation inconspicuous; stamens inserted *c*. 0.7 mm above the corolla base; filaments *c*. 1.3 mm long, broader at the base; anthers *c*. 0.7 mm long, 0.5 mm thick, *truncate* at both ends; ovary 2.8 × 1.7 mm, glabrous; stigma 5 faint ridges. **Fruits** large, 1–2 together; pedicel thick, 10–15 mm long, 3.3–3.5 mm thick, glabrous; *ovoid*, 1.8–4.8 × 1.3–3.4 cm, base obtuse, apex acutish or sometimes tapering at both ends; exocarp scarcely fleshy or *coriaceous*, *wrinkled*, *fissured* when dry with *small white lenticels*, immature pale green to light brown, ripening unknown; mesocarp coriaceous, orangish. **Seed** ellipsoid, *c*. 3.2 × 2 cm; cotyledon strongly folded.

Distribution. Endemic in Peninsular Malaysia, known only from Penang (Penang Hill).

Conservation status. Endangered (EN).

Ecology. Found in secondary forest, at roadsides and open or disturbed areas, to 760 m altitude. Flowering in March, and fruiting in March, July, August and December.

Uses. Not recorded.

Notes and discussion.

1. The fruit shape is most likely to *E. griffithii* but is twice the size and has no scurfy covering.

2. Specimen *W.J.J.O de Wilde & B.E.E. de Wilde-Duyfjes, 21199*, 29 July 1981, Sumatra deposited at Leiden herbarium looks similar to *E. sapotacea* (fruits and leaves characters). At present, *E. sapotacea* is considered as endemic to Peninsular Malaysia. Therefore, further study on the geographical distribution is needed and possibly *E. sapotacea* is also distributed in Sumatra.
3. Measurements of reproductive parts were taken from Hoogland's account since flower material (only known from buds) is available only for type specimens. Therefore SEM observation was not done to avoid damage to the type specimen.

Notes on typification. Many of Curtis specimens' have the same number and locality but different collecting date. Therefore, to indicate a lectotype, observation on the Calcutta specimen is required.

Specimens examined. PENANG. Penang Hill, road to Western Hill, *Kochummen, K.M. FRI 29329*, 8 Sep 1982 (KEP); Government Hill, *Curtis, C. 772*, July 1893 (SING, K); Penang Hill, Upper Tunnel West Road, *Syahida Emiza, S. FRI 66587*, 25 Dec 2009 (KEP).

Fig. 4.11. *Erycibe sapotacea* Hallier *f*. & Prain. A, Habit; B, Cross section of fruits.

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3.3.2.14 *Erycibe stapfiana* **Prain** **Fig. 4.12**

(Honors Otto Stapf, 1857–1953, keeper of the Herbarium Kew, from 1909–1920)

J. As. Soc. Beng. 63, 2 (1894) 87, J. As. Soc. Beng. 74, 2 (1906) 293; Brandis, Indian Trees (1906) 484; Ridley, Fl. Malay Pen. 2 (1923) 448; Burkill & Henderson, Gard. Bull. S. S. 3 (1925) 400; Henderson, Gard. Bull. S. S. 4 (1927) 100; Hoogland *in* Ooststroom, Fl. Malesiana 4 (1953) 423; Hoogland, Blumea 7 (1953) 356; Ng, Tr. Fl. Malaya 4 (1989) 75. **Type:** *Kunsler 4015*, Peninsular Malaysia, Perak, Larut (lectotype CAL; isolectotypes K!, SING!); *Kunstler 4115*, Peninsular Malaysia, Perak, Larut (syntypes E (photo seen), SING!); *Kunstler 7784*, (syntypes BM, G, K, NY); *Parish s.n.*, Myanmar, Tenasserim (*n.v.*); *Scortechini 1793*, Peninsular Malaysia, Perak, Kuala Dipang (syntypes G, L!).

Slender creeper or climber to 24 m tall, stem to 7 cm diameter. **Twigs** almost terete; young branches strigose, older with small orbicular lenticels. **Leaves:** petioles almost terete, older with conspicuous *ring-like*, 7–10 mm long, 1–2 mm thick, shallowly channelled above at base, sparsely hairy to glabrous; laminas elliptic-oblong to oblong, 8.5–17(–20) × 3–7(–8.5) cm, *chartaceous*, glabrous on both surfaces, dry leaves *glossy green to pale brown to grey*, base cuneate, margin flat, apex acuminate; midrib *prominent*, glabrous both surfaces; lateral veins prominent both surfaces, 5–7 pairs, ending close to margin; intercostal veins *closely transverse order*, prominent above, *strongly* prominent beneath. **Inflorescences** terminal and axillary, paniculate, 2–4 together, to 6.5 mm long, 4–25-flowered; pedicels 2–4 mm long, densely stellate-hairy; bracteoles elliptic, 0.8–1.2 × 1 mm, densely stellate-hairy outside, sparsely to densely stellate-hairy inside inside. **Flowers:** buds to 2.5 mm diameter, densely stellate-hairy; two outer sepals orbicular, 3–3.5 × 3–3.5 mm, three inner sepals orbicular to transverse-oval, 1.9–2.2 × 1.9–2.5 mm, densely stellate-hirsute outside,

hairs stalked, 5–8-subequal branched, longest branches to 130 μm long, longitudinal veins conspicuous; corolla waxy white or creamy, 9–11 mm long, 16–18 mm across, tube 2–2.5 mm long; midpetaline bands 4–5 × 3–3.5 mm, fleshy, densely stellate hairy, hairs stalked, *dendritic*, 7–8-subequal branched or one longer to 284 μm long; corolla lobes 9–11 mm long, 9–10 mm across; lobules coherent above the midpetaline bands at *c*.0.5 mm, oblong, 8–9 × 3.5–4.5 mm, margin entire or minutely crenate-serrate, longitudinal venation conspicuous; stamens inserted *c*. 0.5 mm above the corolla base; filaments 1.8–2 mm long, triangular or broader at the base; anthers 0.6–0.8 mm long, *c*. 1 mm thick, base cordate, apex acuminate; ovary 0.7–1.2 × 0.8–1.3 mm, glabrous or glabrous at lower part, densely short stellate-hirsute at the upper part; stigma 5-ridged. **Fruits** pedicel 4–10 mm long, *c.* 1 mm thick, densely short stellate-hairy; obpyriform or sometimes ellipsoid, (0.8–)1.5–2.2(–3.6) × (0.8–)1–1.3(–2.7) cm, base obtuse, apex tapered; *exocarp* coriaceous or little fleshy, densely short brown *stellate-hairy*, immature and ripening colour unknown; mesocarp unknown. **Seed:** cotyledons flat

Vernacular name. *Akar Daging*, *Akar Jawi* (Temuan).

Distribution. Peninsular Myanmar, Thailand, and Peninsular Malaysia. In Peninsular Malaysia, known from Perak, Pahang, Selangor and Johor.

Conservation status. Least Concern (LC).

Ecology. Found in primary and dense forest at rich soil from 90 to 1200 m altitude. Flowering in March, April and September and fruiting in February, June, July, August and October.

Uses. Not recorded.

Notes and discussion.

1. From my observations, the most remarkable characters for the species is the intercostals venation is very conspicuous and the lamina drying is glossy green to pale brown to grey on both surfaces.
2. The closely related species is *E. griffithii* which sometimes has very conspicuous intercostals venation but the lamina drying is dark brown or brown reddish colour.
3. This species was recently collected from Thailand (*D. J. Middleton, 2245*). It has expands its distribution range to Thailand.

Specimens examined. JOHOR. Panti F.R., Cpt. 51, *Yong, F.C. KEP 99427,* 18 Jul 1961 (KEP) – **PAHANG.** Chini F.R., *Bray, P.S. FRI 11635,* 6 Oct 1968 (KEP,K); Fraser's Hill, *Mohamed Nur SFN 11293,* 7 Sep 1923 (KEP,SING); Fraser's Hill, Big Tree Plot, *Kochummen, K.M. FRI 2647,* 12 Feb 1969 (KEP,L) – **PERAK.** Perak, *King's collector 8104,* August 1885 (SING); *Scortechini s.n* (K,L); Kuala Dipang F.R., *Scortechini 1793* (L); Kinta Dam, *Syahida Emiza, S. FRI 66741,* 5 April 2010 (KEP); Larut, *Wray, L. 3371,* April 1889 (SING); *King's collector 4015,* March 1883 (SING, K); *King's collector 4115,* April 1883 (SING) – **PAHANG.** Pahang Rd., *Kochummen, K.M. FRI 18366,* 26 Jun 1976 (KEP,L,K); Kuala Pansom, *Gadoh, U. KL 1323,* 18 Jan 1959 (KEP,L,K); *Gadoh, U. KL 2166,* 1 Aug 1960 (KEP,K,L,SING).

Other specimens examined. THAILAND. Kaeng Krachan N.P., *D. J. Middleton 2245*, 19 Jan 2004 (KEP, BKF).

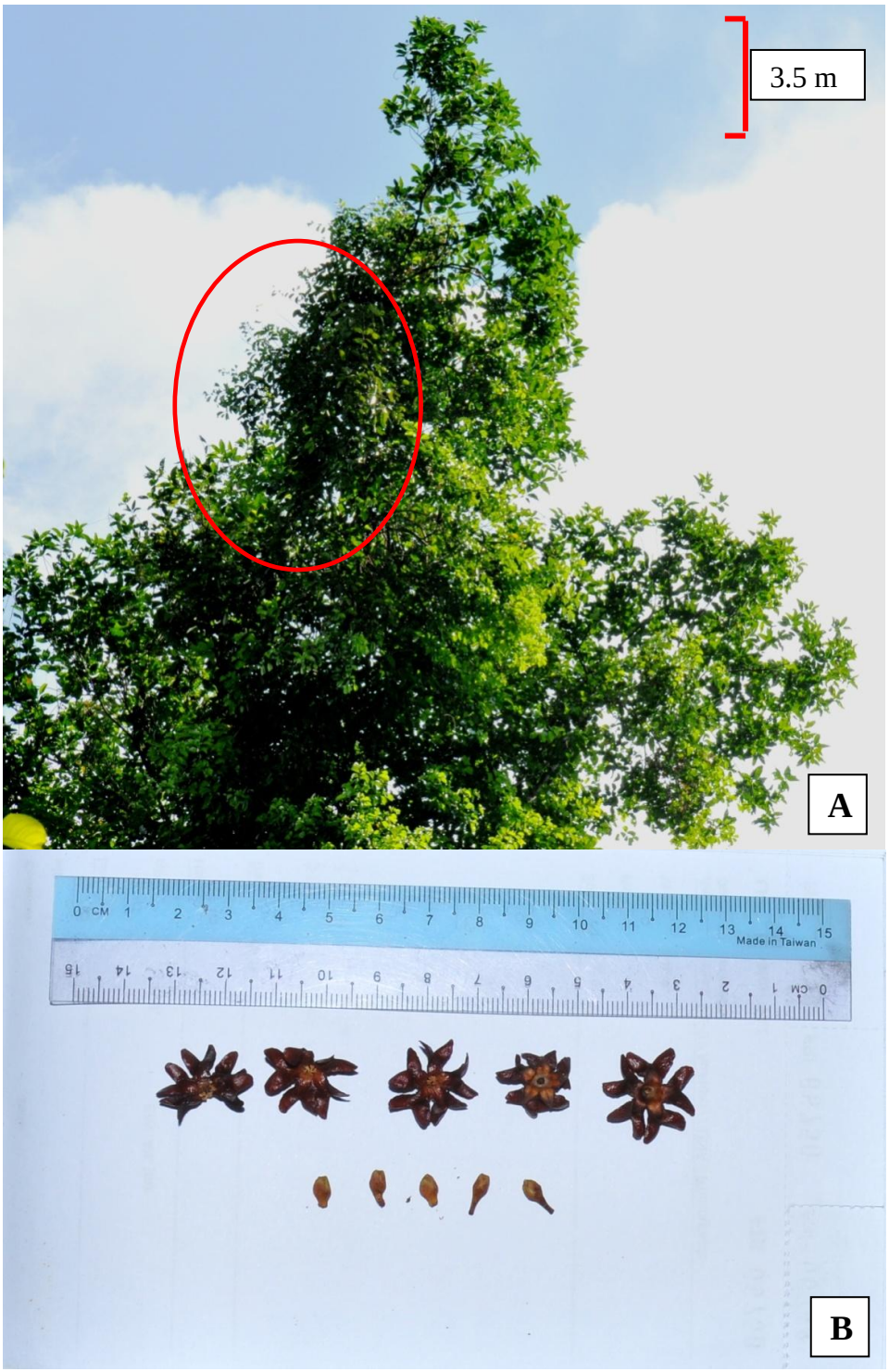


Fig. 4.12. *Erycibe stapfiana* Prain. A, Habit, climb to the top of tree canopy; B, The dry flowers and flower buds.

4.3.2.15 *Erycibe strigosa* Prain

(Latin, *strigosus* = covered in straight, stiff, rather short, bristle-like appressed hairs)

J. As. Soc. Beng. 65, 2 (1896) 536, J. As. Soc. Beng. 74, 2, (1906) 288; Ridley, Fl. Malay Pen. 2 (1923) 445; Burkill & Henderson, Gard. Bull. S. S. 3 (1925) 400; Hoogland *in* Ooststroom, Fl. Malesiana 4 (1953) 416; Hoogland, Blumea 7, (1953) 356; Ng, Tr. Fl. Malaya 4 (1989) 75. **Type:** *Kunstler 8461*, Peninsular Malaysia, Perak, Taiping (lectotype CAL; isolectypes G, K!, L! [photo!], SING!).

Climber to 18 m tall, stem 2–5 cm diameter. **Twigs** terete, young branches densely thin strigose, older with longitudinally ridged. **Leaves:** petioles angular, 12–20 mm long, 1–2 mm thick, densely *strigose-hairy*; laminas elliptic-oblong, 7–12 × 3.5–6.5 cm, coriaceous, glabrous above, densely black and long *strigose* beneath, dry leaves dull brown, base acute or obtuse, margin flat, apex long acuminate, 1.4–1.6 cm long; midrib sunken, glabrous above, prominent, *strigose-hairy* beneath; lateral veins sunken above, prominent beneath, 6–7 pairs, ending looping close to margin; intercostal veins reticulate, inconspicuous above, prominent beneth. **Inflorescences** axillary, paniculate, 2 to 3 together, to 26 cm long, the longer ones with small leaves at the basal part; 20–60-flowered; pedicels 1–2 mm long, densely strigose; bracteoles elliptic, *c.* 5 × 2 mm, densely strigose-hairy both sides. **Flowers** known only from buds; buds to 2 mm diameter, densely strigose; two outer sepals oval, *c*. 2.5 × 2 mm, three inner sepals transverse-oval, 2 × 2.5 mm, *strigose* outside, *2-branched hairs*, longest branches to 500 μm long, longitudinal veins inconspicuous (from Hoogland in Ooststroom); corolla just developed, brownish grey; midpetaline bands densely *strigose*, *2-branched hairs*, longest branches to 800 μm long (from Hoogland in

Ooststroom); anthers base cordate, apex acuminate; ovary glabrous; stigma conical. **Fruits** unknown.

Distribution: Endemic to Peninsular Malaysia, known only from Perak (Taiping, once collected).

Conservation status. Data deficient (DD).

Ecology: In dense jungle from 150 to 240 m altitude, reported clinging to trees. Flowering in February.

Uses. Not recorded.

Notes and discussion.

1. This species is known only from the type specimen, which has very young flower buds. It is characterised by 2-branched hairs on both the calyx and midpetaline bands and long strigose hairs on the leaf under surface.
2. The dry leaf is most likely to *E. festiva* which is dull brown but *E. strigosa* leaf is strigose-hairy on the leaf beneath while *E. festiva* leaf is glabrous on both surfaces.

Specimens examined. PERAK. Taiping, *King's collector 8461*, February 1886 (SING,K,L).

4.3.2.16 *Erycibe tomentosa* Blume var. *tomentosa* Blume

(Latin, *tomentosus* = covered in downy hairs)

Bijdr. Fl. Ned. Ind. 16 (1826) 1048; Don, Gen. Hist. Dichl. Pl. 4 (1838) 392; De Candolle, Prodr. 9 (1845) 464; Miquel, Fl. Ned. Ind. 2 (1859) 1033; Hoogland *in* Ooststroom, Fl. Malesiana 4 (1953) 426; Hoogland, Blumea 7 (1953) 359; Ng, Tr. Fl. Malaya 4 (1989) 76. **Type:** *Blume 1355*, Java, Mount Parang (lectotype L! (barcode. no. L0004171, L0004172 & L0004173); isolectotype L!) **Synonym:** *Erycibe princii* Wall. *ex* Choisy, Ann. Sc. Nat. Ser. 2, 1 (1834) 224; Don, Gen. Hist. Dichl. Pl. 4 (1838) 392 (*E. princei*); De Candolle, Prodr. 9 (1845) 464 (*E. princei*); Miquel, Fl. Ned. Ind. 2 (1859) 1033 (*E. princei*); Clarke, Fl. Brit. India 4 (1883) 182; Prain, J. As. Soc. Beng. 63, 2 (1894) 85, J. As. Soc. Beng. 74, 2 (1906) 290; Hallier *f*., *in* Engler, Bot. Jahrb. 49 (1913) 376; Ridley, Fl. Malay Pen. 2 (1923) 446; Burkill, Econ. Prod. Malay Pen. 1 (1966) 959 (*E. princei*); Henderson, Malay. Wild Flowers, Monocot. 2 (1650) 313. **Type**: *Wallich 1335*, Singapore (holotype G [photo!]); isotype B, K)

Climber to 25 m tall. **Twigs** terete**;** young branches densely *stellate-hirsute*, older glabrescent with distinct longitudinal ridges. **Leaves:** petioles, terete, 2–4 mm long, 1–1.1 mm thick, densely stellate-hirsute; laminas obovate or ovate-oblong, 4.5–11.5 × 2–7 cm, coriaceous, glabrous above, almost glabrous beneath, dry leaves pale to dark green, base almost cordate or rarely obtuse, margin flat, apex obtuse or acuminate to broad acute; midrib sunken, glabrous above, prominent, almost glabrous beneath, lateral veins prominent both surfaces, 5–8 pairs, ending close to margin or clearly looping; intercostal veins reticulate, prominent both sides. **Inflorescences** terminal leafy panicle (or flowers raceme in a short cluster), 1–4, terminal inflorescence to 9 cm long, densely stellate-hirsute,

3–15(–25)-flowered; pedicels 1.5–3 mm long, densely stellate-hirsute; bracteoles ovate, 2–3 × 1 mm, densely stellate-hirsute both sides. **Flowers:** buds to 4 mm diameter, densely stellate-hirsute; two outer sepals orbicular to transverse-oval, 3–4 × 3–5 mm, three inner sepals transverse-oval, 3.5–4 × 4–5 mm, sparsely stellate-hirsute outside at upper part and rather dense at lower part, hairs nearly sessile, 2–5-subequal branched, longest branches to 500 μm long, longitudinal veins conspicuous; corolla white, 8–10 mm long, 5–6 mm across, tube *c.* 0.5 mm long; midpetaline bands 2–3 × 1.2–2 mm, densely long appressed-hairy, generally orange-brown colour, hairs nearly sessile, 3–4-unequal branched, one branch longer to 680 μm long; corolla lobes 4–5 mm long, 2–3 mm across; lobules coherent above the midpetaline at 1–1.5 mm, oblong, 3–3.5 x 1.5–1.8 mm, fleshy, margin *crenate,* longitudinal venation *inconspicuous*; stamens inserted 0.8–1.2 mm above the corolla base; filaments 1–1.3 mm long, broader at the base; anthers 0.8–0.9 mm long, *c.* 1 mm thick, base almost cordate, apex acuminate; ovary 1–1.2 × 1 mm, glabrous; stigma 5-ridged. **Fruits** pedicel 3–5 mm long, *c.* 1 mm thick, stellate-hirsute; ellipsoid to ovoid, 1–1.2 × 0.6–0.8 cm, base obtuse, apex acute; exocarp thin, glabrous, *wrinkled* when dry, immature *green to orange-reddish*, ripening *blackish*; mesocarp unknown. **Seed:** cotyledon flat.

Distribution: Philippines, Borneo, Sumatra, West Java, Madura, Kangean Island and Peninsular Malaysia. In Peninsular Malaysia, recorded in Perak, Negeri Sembilan, Melaka and Johor.

Ecology: Found on localities of about 20 m altitude and in scrub forest. Flowering in January, March, April and October and fruiting in March, April, May and November.

Uses. The long slender stem is used for binding fences (Hoogland, 1953a). On the specimen label, *Alvins 1280*, it was mentioned that a poultice was applied to the head in cases of headache.

Notes and discussion.

1. From my observations, the most remarkable characters between these two varieties are the leaf shape and indumentum on abaxial surface. Typical leaf of *E. tomentosa* var. *tomentosa* is abovate and almost glabrous on abaxial leaf surface but var. *hirsuta* has ovate oblong or ovate lamina and densely long stellate-hirsute on abaxial leaf surface.

Specimens examined. JOHOR. Kuala Sembrong, *Lake s.n.*, 20 Oct 1892 (SING); P. Simpang, *Ng, F.S.P. FRI 5055*, 17 Apr 1967 (KEP,K,L) – **MELAKA.** Malacca, *Maingay, A.C. 1155* (L); *Alvins, M.V. 1280*, 30 March 1885 (SING); Brisu, *Derry, R. 412*, March 1890 (SING); Malacca, *Alvins, M.V. 630* (SING); *Ridley, H.N. s.n.*, 1890 (SING); *Alvins, M.V. s.n.* (SING); Selandar, *Alvins, M.V. 240*, 21 January 1885 (SING); Ayer Panas, *Alvins, M.V. s.n.*, 27 January 1886 (SING); Bkt. Bruang, *Derry, R. 1231*, 6 May 1893 (SING) – **NEGERI SEMBILAN.** Kuala Pilah, *Holttum, R.E. 9803*, 29 November 1922 (SING); Bemban, *Alvins, M.V. s.n.*, 9 April 1886 (SING) – **PERAK.** Perak, *Anonymous s.n.* (SING).

4.3.2.17 *Erycibe tomentosa* Blume var. *hirsuta* (Hallier *f*.) Hoogland Fig. 4.13

(Latin, *hirsutus* = covered in set with rough bristles-like hairs)

Hoogland *in* Ooststroom, Fl. Malesiana 4 (1953) 428; Hoogland, Blumea 7 (1953) 358; Ng, Tr. Fl. Malaya 4 (1989) 75. **Basionym:** *Erycibe hirsuta* Hallier *f*., *in* Engler, Bot. Jahrb. 49 (1913) 376. **Type:** *Winkler 3337*, South East Borneo, between Lampiung and Patung (holotype HBG; isotype B, BM, BO, K!, L!)

Twigs terete; young branches densely stellate-hirsute, older longitudinal ridges. **Leaves:** petioles terete, 1–2 mm long, *c*. 1 mm thick, densely stellate-hirsute; laminas ovate oblong or ovate, 4–9 × 1.5–4 cm, *thinly coriaceous*, almost glabrous above, densely long stellate-hirsute beneath, base almost cordate, margin flat, apex acuminate; midrib sunken, sparsely stellate-hirsute above, prominent, densely stellate-hirsute beneath, lateral veins prominent both surfaces, 4–6 pairs, curving close to margin; intercostal veins reticulate, inconspicuous above, prominent beneath. **Inflorescences** terminal leafy panicle (or flowers raceme in a short cluster), to 3.5 cm long, *densely stellate-hirsute*; pedicels 1–2 mm long, densely stellate-hirsute; bracteoles linear, 1–1.5 × 0.5–1 mm, densely stellate-hirsute both sides. **Flowers:** sepal mostly 3 branched hairs outside, one branch stronger and longer, to 750 μm long (from Hoogland in Ooststroom); midpetaline bands hairs mostly to 2000 μm long (from Hoogland in Ooststroom). **Fruit** unknown.

Distribution: Sumatra, Peninsular Malaysia, Borneo and Singapore. In Peninsular Malaysia, recorded in Johor (Sg. Kayu, only collected once).

Ecology: Found near a swampy area. Flowering in March.

Uses. Not recorded.

Specimens examined. JOHOR. Sg. Kayu, *Kiah, S. SFN 32367*, 10 March 1937 (SING,L,K).

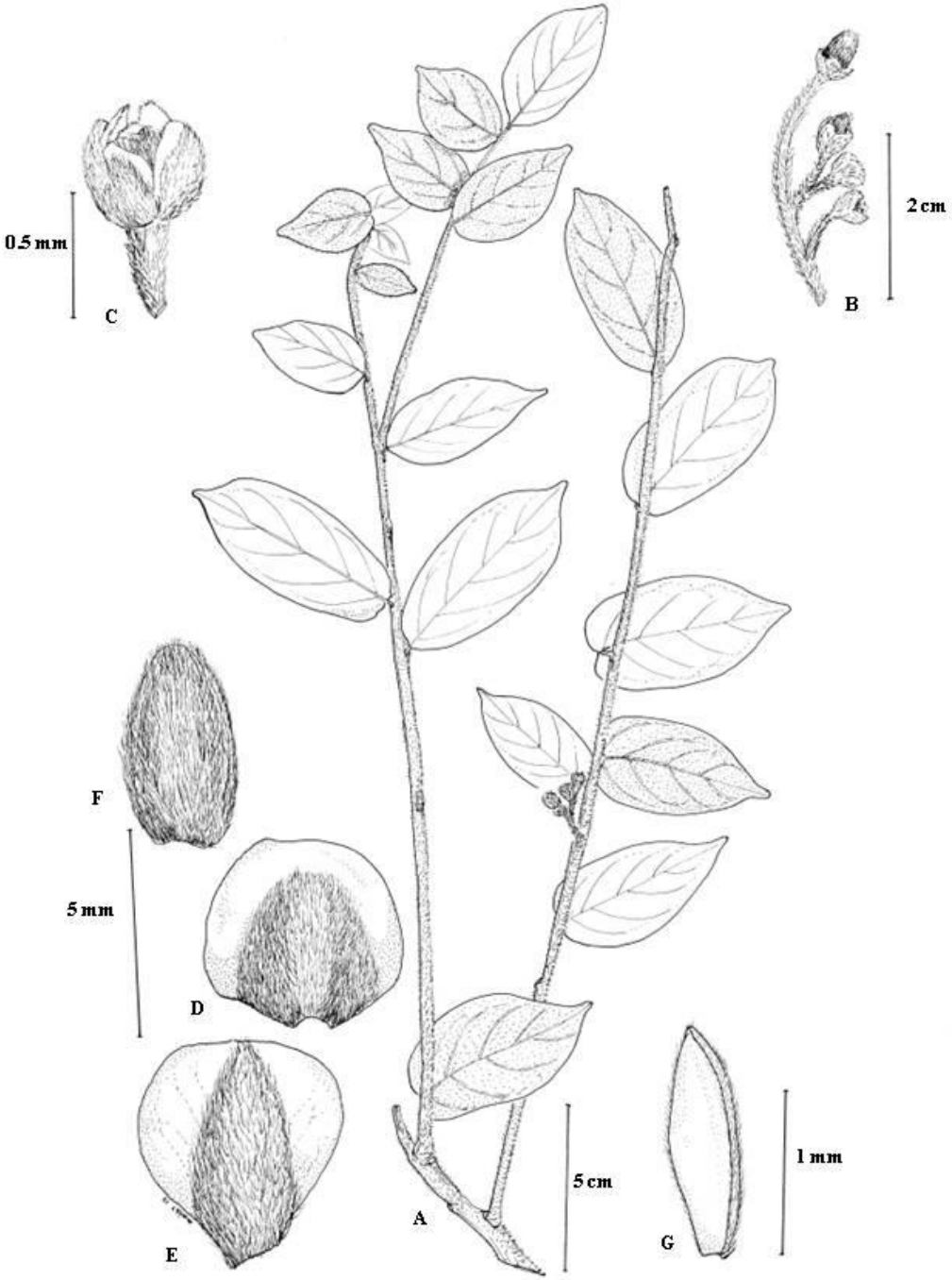


Fig. 4.13. Illustration of *Erycibe tomentosa* Blume var. *hirsuta* (Hallier *f*.) Hoogland. A, habit; B, inflorescence; C, flowerbud; D, outer sepal; E, inner sepal; F, bracteole; G, bracteole from side view (A–G from *SFN 32367*).

4.3.2.18 *Erycibe* sp. A

Woody climber. **Twigs** terete; young branches *stellate-hirsute*, older glabrous with a few orbicular lenticels. **Leaves:** petioles angular, 7–14 mm long, 2–3 mm thick, *densely stellate-hirsute* but soon glabrescent; lamina elliptic to oblong, 5–14 × 2–6 cm, *thickly coriaceous*, glabrous above, *densely stellate-hirsute beneath*, dry leaves *brown to dark brown*, base cordate, rarely obtuse, margin flat, apex short acuminate, rarely acute; midrib sunken, glabrous above, prominent, *densely stellate-hirsute beneath*; lateral veins almost sunken above, prominent, densely stellate-hirsute beneath, 5–8 pairs, curving almost 45° and ending close to the margin, densely stellate-hirsute; intercostal veins closely transverse order, inconspicuous above, faintly conspicuous beneath. **Inflorescences** *terminal* and *axillary*, glomerules, 0.6–1.2 cm long, (1–)3–10(–15)-flowered; pedicels *none* or very short, *c*. 1 mm long, densely stellate-hirsute; bracteoles linear or elliptic, 2–3 × 0.5 mm, densely stellate-hirsute both sides. **Flowers** known from buds or very young flower, buds to 2.5 mm diameter, densely stellate-hirsute; sepal thickly fleshy, two outer sepals orbicular to transverse oval, *c.* 2 × 2–3 mm, three inner sepals ovate, 2.5–3 × 2–2.5 mm, densely *stellate-hirsute* outside, hairs stalked, 4–6-unequal branched, curled, one longer to 600 μm long, longitudinal veins inconspicuous; corolla lemon yellow, *c*. 5 mm long, *c*. 8 mm across, tube *c*. 0.5 mm long; midpetaline bands 2–2.5 × 1–1.5 mm, densely stellate-hairy, hairs stalked, 3–5-unequal branched, one longer to 720 μm long; corolla lobes *c*. 2.5 mm long, *c*. 1.5 mm across; lobules coherent above the midpetaline at *c*. 0.5 mm, oblong, *c*. 2 x 1 mm, thinly fleshy, margin entire, longitudinal venation inconspicuous; stamens inserted at the corolla base; filaments short, *c*. 0.5 mm long, slender; anthers *c*. 1 mm long, *c*. 1 mm

thick, base almost cordate, apex acuminate; ovary *c*. 0.5 × 0.5 mm, glabrous or sparsely hairy at lower part, glabrous at upper part; stigma 10-ridged. **Fruit:** unknown

Distribution. In Peninsular Malaysia known only from Upper Camp, Gunung Belumut, Johor.

Conservation status. Not Evaluated (NT).

Ecology. In primary forest on hillside at about 400 m altitude. Flowering in May. Flowers are sweetly fragrant.

Uses. Not recorded.

Notes and discussion.

1. Only three specimens were available for study (*Whitmore, FRI 8850, Tong, S., S32819* and *Aban Gibot, SAN72913*). The specimen *Whitmore, FRI 8850*, was collected from Gunung Belumut, Johor, in 1968.
2. Most flowers are in bud except only one opened flower but still at young stage. The glomerules inflorescences are terminal and axillary and the densely stellate-hirsute indumentum under lamina surface differentiate this specimen from all other species occuring in Peninsular Malaysia.
3. Specimens *Tong, S., S32819,* 8 March 1973, Lawas, Sarawak (specimen with single fruit) and *Aban Gibot, SAN72913*, 7 September 1983, Sabah (specimen with flower buds) deposited at KEP herbarium looks similar to *E*. sp. A in the flower buds and leaves characters. However, there are still not enough materials as no matured flowers

are available to compare the Peninsular Malaysia specimen with the Borneon specimens.

Specimens examined. JOHOR. Kluang F.R., G. Belumut, *Whitmore, T.C. FRI 8850*, 17 May 1968 (KEP,L,K,SING).

4.3.2.19 *Erycibe* sp. B

Woody climber. **Twigs** angular; young branches densely short *stellate-hirsute*, older almost glabrous with distinct longitudinal ridges. **Leaves:** petioles terete, 7–14 mm long, 2–3 mm thick, densely stellate-hirsute but soon glabrescent; lamina oval-elliptic to oblong, 9.8–16 × 5.7–8.5 cm, thickly coriaceous, glabrous above, densely *stellate-hirsute* on all parts *beneath*, rarely punctate, dry leaves always brownish, base almost obtuse, margin flat, apex cuspidate with blunt tip; midrib sunken, glabrous above, prominent, hairy beneath; lateral veins faintly conspicous above, prominent beneath, 4–6 pairs, curving and ending close to the margin; intercostal veins reticulate, inconspicuous above, sunken beneath. **Inflorescences** axillary, racemose; bracteoles elliptic or obovate, 3.5–5 × 2–2.2 mm, densely stellate-hirsute both sides. **Flowers** known only from buds, buds to 3 mm diameter, densely stellate-hirsute; two outer sepals orbicular, 3.5–4.5 × 3.5–4.5 mm, three inner sepals ovate, *c.* 3 × 2.5 mm, densely stellate-hirsute outside, hairs stalked, 4–5 or more subequal-branched, longest branches to 180 μm long, longitudinal veins inconspicuous; corolla colour unknown; midpetaline bands *c.* 2 × 1.5 mm; filaments very short, *c.* 0.5 mm long, slender; anthers *c.* 0.7 mm long, *c.* 0.7 mm thick, base almost cordate, apex cuspidate; ovary *c.* 0.5 × 0.5 mm, glabrous or glabrous at lower part, sparsely stellate-hairy at upper part; stigma 5-ridged. **Fruits:** pedicel 4–10 mm long, 1.5–2 mm thick, densely stellate-hirsute; ellipsoid or globular, 1.8–2.1 × 1.5–1.8 cm, obtuse at both ends; exocarp thick, glabrous, immature green to orange, ripening blackish; mesocarp unknown. **Seed:** unknown.

Distribution. In Peninsular Malaysia known from Selangor, Kelantan, Pahang, Negeri Sembilan and Melaka.

Conservation status. Not Evaluated (NT).

Ecology. In primary forest at lowland from 30 to 120 m altitude. Flowering in November and fruiting in June and October.

Uses. Not recorded.

Notes and discussion.

1. This taxa is different from other Peninsular Malaysia *Erycibe* species by having; densely stellate-hirsute with very conspicuous ridges twigs, inflorescences axillary racemes and densely stellate-hirsute on abaxial leaf surface on all parts.
2. Although there were flower buds and fruits on the herbarium specimens (*Alvis 2156*, Bukit Kupayiang, Negeri Sembilan), the specimens lacked many important characters such as matured reproductive characters making it not appopriate to be published as new taxa. Hence, the specimens were maintained as *Erycibe* sp. B.

Specimens examined. KELANTAN. Kuala Balah, *Soepadmo, E. s 299*, 20 Aug 1990 (L) – **MELAKA.** Malacca, *Alvins, M.V. s .n.* (SING) – **NEGERI SEMBILAN.** Bkt. Kepayang, *Alvins, M.V. 2156*, 11 November 1885 (SING); Pasoh F.R., *Gardette, E. EG 2015*, 18 Jun 1996 (KEP,K,L,SING) – **PAHANG.** Chini F.R., Bkt. Chini, *Cockburn, P.F. FRI 11083*, 5 Oct 1968 (KEP,K,L) – S**ELANGOR.** Kuala Pansom, *Gadoh, U. KL 1677*, 19 Aug 1959 (KEP,L,K,SING).

CHAPTER 5

CONSERVATION STATUS ASSESSMENT

5.1 Introduction

The tropical rain forest of Malaysia is one of the most complex and unique ecosystems in the world. Ashton (2008) has estimated that more than half the total diversity of this world is sequestered in lowland evergreen tropical rain forest. The forest consists of biodiversity components such as plants, animals, microorganisms, the ecosystems to which they belong, and the diversity within species, between species, and of ecosystems (Anon., 2008). It is clear that the contribution of plants, whether of trees, lianas, herbaceous plants and epiphytes to biodiversity richness is immense. One of the significant characters of tropical rain forest is the abundance of climbing plants, especially woody climbers such as lianas, which present in both primary and secondary forest and are obvious in gaps and clearings (Richards, 1996; Schnitzer & Bongers, 2002). Lianas alone represent about 25% of the woody stem density and species diversity in many tropical forests (Gentry, 1991; Appanah *et al*., 1992).

The estimated total number of species of the flora of Malaysia is about 15,000. Of these approximately 8,900 vascular plant taxa (species, subspecies and varieties) occur in Peninsular Malaysia, including over 8,200 native and 690 naturalized species (Saw *et al*., 2009).

In addition, the flora of Peninsular Malaysia includes many endemic (restricted in geographical distribution) or rare species. Ng *et al*. (1990) estimated that 746 (26.36%) species of the total 2,830 tree species are endemic. Furthermore, Kiew (1991) estimated endemism in large genera of herbaceous plants with more than 40 species ranged from

about 87% to 96%. However, specific figures for endemic liana species are not known because we still lack data for lianas including their ecology and their role in forest dynamics. The above figures show that it is essential to have conservation monitoring of our flora.

Human activities have fundamentally transformed most ecosystems on the planet, especially in the last 50 years, and have changed the diversity of life on earth and caused a loss of biodiversity (Anon, 2008). At present, increasing changes in land use and conversion to plantations, agriculture and urbanization are critically contributing to the biodiversity erosion that may also directly affect species extinctions. In 1960, 70% of Peninsular Malaysia's land was under natural forest cover but by 2002 it has declined to 40.7% (Anon., 2008).

In 1998, World Conservation and Monitoring Centre (WCMC), in collaboration with the International Union for Conservation of Nature (IUCN), Species Survival Commission (SSC) and other experts worldwide, produced The World List of Threatened Trees and the accompanying Tree Conservation Database (referred together as the Threatened Tree List) (Oldfield, S. *et al*., 1998). A number of Malaysian plants were listed and identified according to IUCN categories and criteria with 197 species listed as critically endangered (CR), 106 as endangered (EN) and 434 as vulnerable (VU). The number of threatened species will increase if no action is taken particularly with a conservation approach, without which we certainly will lose some valuable species in the future.

IUCN in the World Conservation Strategy (1980) defines conservation as the management of human use of the biosphere so that it may yield the greatest sustainable benefit to present generations while maintaining its potential to meet the needs and aspirations of future generations.

As a party to the Convention on Biological Diversity (CBD), Malaysia is extensively committed to the management and conservation of biodiversity and plant resources in the country. A Malaysian National Strategy for Plant Conservation has been set up to consolidate past and existing efforts towards biological diversity conservation (Saw *et al*., 2009). Through the seventeen targets, the National Strategy for Plant Conservation offers a detailed assessment of what has been achieved by Malaysia in its efforts to protect its natural biodiversity heritage and recognizes more requirements needed to strengthen the conservation of plant resources.

Also, the Malaysian Red List Project was set up in 2006 to produce an assessment of the conservation status and threats for indigenous plant species in Malaysia (Chua & Saw, 2006). Therefore, conservation assessments are conducted for *Erycibe* species in Peninsular Malaysia to identify threats and conservation status for each species/taxon.

5.2 Protected Areas

In 2009, Peninsular Malaysia had 5.87 million hectares or 44.56% forested area of its total land area (Forestry Statistics Peninsular Malaysia, 2009). In line with the concept of sustainable natural forest management and conservation, many protected areas were established since 1930's under federal and state legislation either as Permanent Reserve Forest (PRF) previously known as Permanent Forest Estate (PFE), national parks, state parks, wildlife reserves, wildlife sanctuaries and others. Of these, 4.81 million hectares and 586 thousand hectares have been gazetted as PRF and wildlife reserves respectively. In addition, the Forestry Departments have established Virgin Jungle Reserves (VJRs) to serve as permanent natural reserves and arboreta and as undisturbed natural forests for general ecological and botanical studies (Abdul Khalim & Samsudin, 1997).

5.3 Aims

The objective of this study was to assess the level of threats and conservation status of species in the genus *Erycibe* in Peninsular Malaysia. With the available list of threatened species/taxa, conservation monitoring can be done on the species/taxon.

5.4 Materials and methods

To produce the distribution map of each taxa, all data from the studied herbarium specimens (from BKF, K, KEP, KLU, L, SING and UKMB) including specimen localities were entered into Botanical Research and Herbarium Management System (BRAHMS) database software. The appropriate data of co-ordinates of the locality for each specimen was taken from BRAHMS database which is essential to ensure accurate plotting of distribution maps. These data were saved as dbf format, which can be used/read using ArcView GIS 3.2a software. The ArcView GIS 3.2a software has been used to plot and prepare a distribution map for a particular species/taxon.

To assess the conservation status for each species/taxon, three values need to be considered: Extent of Occurrence (EOO), Area of Occupancy (AOO) and the percentage of forest cover. An additional map was prepared using the same software (ArcView GIS 3.2a). EOO, AOO and the percentage of forest cover were calculated from the map produced. A grid size of 2 km (a cell area of 4 km^2) is a suitable scale and has been used to estimate AOO value. The true AOO value was calculated by Conservation Assessment ToolS (CATS).

The conservation status assessment of each species/taxon was assessed and a threat category given by filling in the Taxon Data Information Sheet (TDIS) (Appendix A or

electronic copy available at http://www.tfbc.frim.gov.my/MalaysiaPlantRedList.pdf) based on the guidelines and criteria of the Malaysia Plant Red List (Chua & Saw, 2006). For these *Erycibe* species, data were based from the literature, geo-referenced herbarium specimens and two years field work observations from year 2008 until 2010. The TDIS contains information on five main parts; Taxon Attributes (part I), Geographic Range & Demographic Details of Population(s) (part II), Red List Category & Criteria Assessment (part III), Current Conservation Measures for The Taxon (part IV) and Utilization (part V). All the information provides rationale to support the Red List category given to the taxon concerned. The criterion specifies six categories: Extinct (EX), Extinct in the Wild (EW), Critically Endangered (CR), Endangered (EN), Vulnerable (VU), Near Threatened (NT), Least Concern (LC), Data Deficient (DD) and Not Evaluated (NE). Under Red List Category & Criteria Assessment (29), species/taxon categorised as CR, EN and VU are collectively referred as threatened, and required supporting documents or reasons to qualify the categories. There are five criteria used to determine whether a species/taxon belongs to a threatened category (Appendix B or electronic copy available at http://www.iucn.org). The assessment was evaluated by the Secretariat of the Threat Assessment Project Flora of Peninsular Malaysia/National Assessor undertaken by the Forest Research Institute Malaysia (FRIM).

5.5 Results

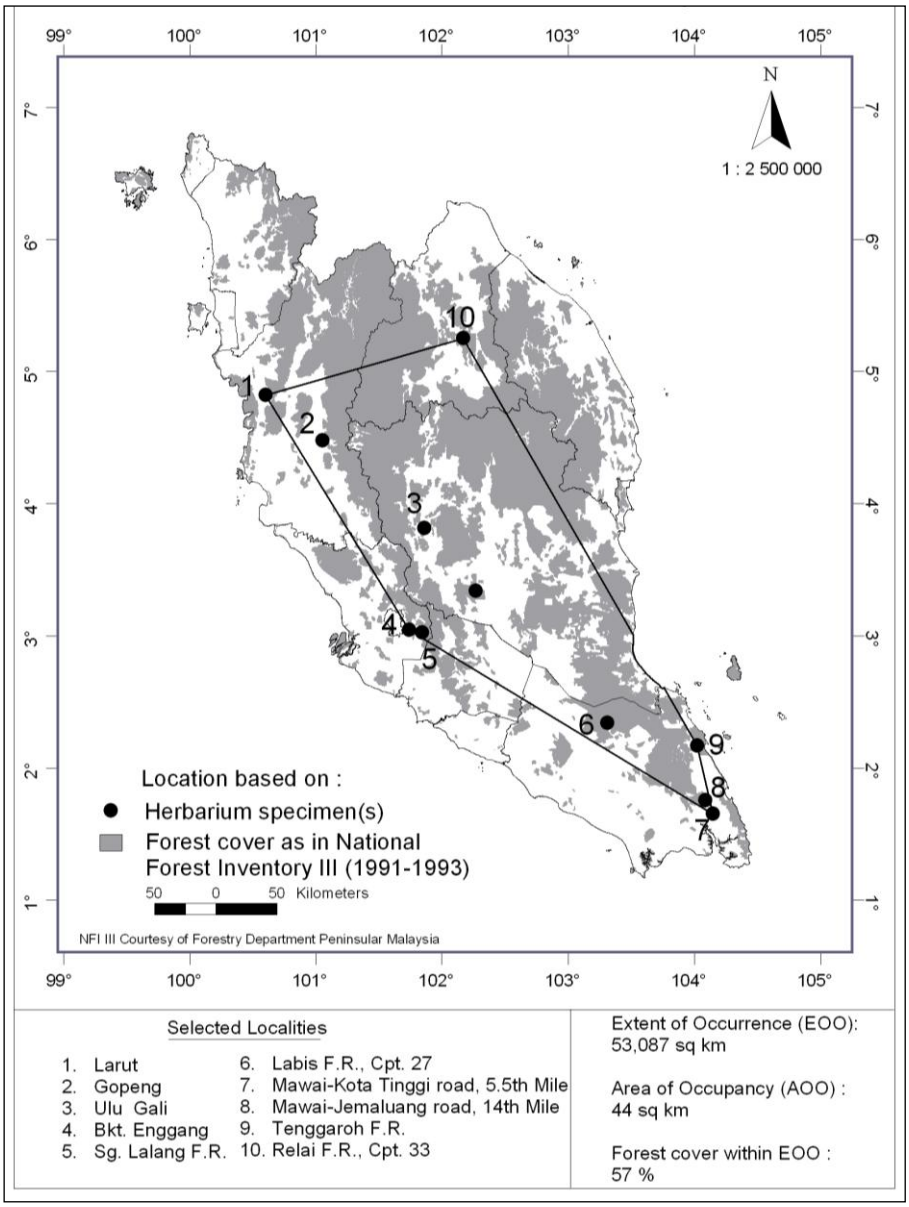
5.5.1 *Erycibe aenea* **Map 5.1**

Conservation Status: Least Concern (LC)

Habitat and ecology: *Erycibe aenea* usually climbs on large trees in primary forest and hill sides to 760 m altitude, in secondary forest or open and logged-over forest and on roadsides.

Locality: *Erycibe aenea* has a wide distribution and is found in Johor, Kelantan, Pahang, Perak and Selangor (Map 5.1). In many places in Johor, Kelantan and Selangor, *E. aenea* was found in forest reserves. More recently, a collection was made from Tenggaroh Forest Reserve in Johor, along a logged-over forest trail. *Erycibe aenea* is not endemic and also occurs in Sumatra (Hoogland, 1953a).

Threats: No major threat is identified. The species is used only in small amount by local people as a medicine (Burkill, 1966).



Map 5.1. Geographical distribution of *Erycibe aenea* in Peninsular Malaysia.

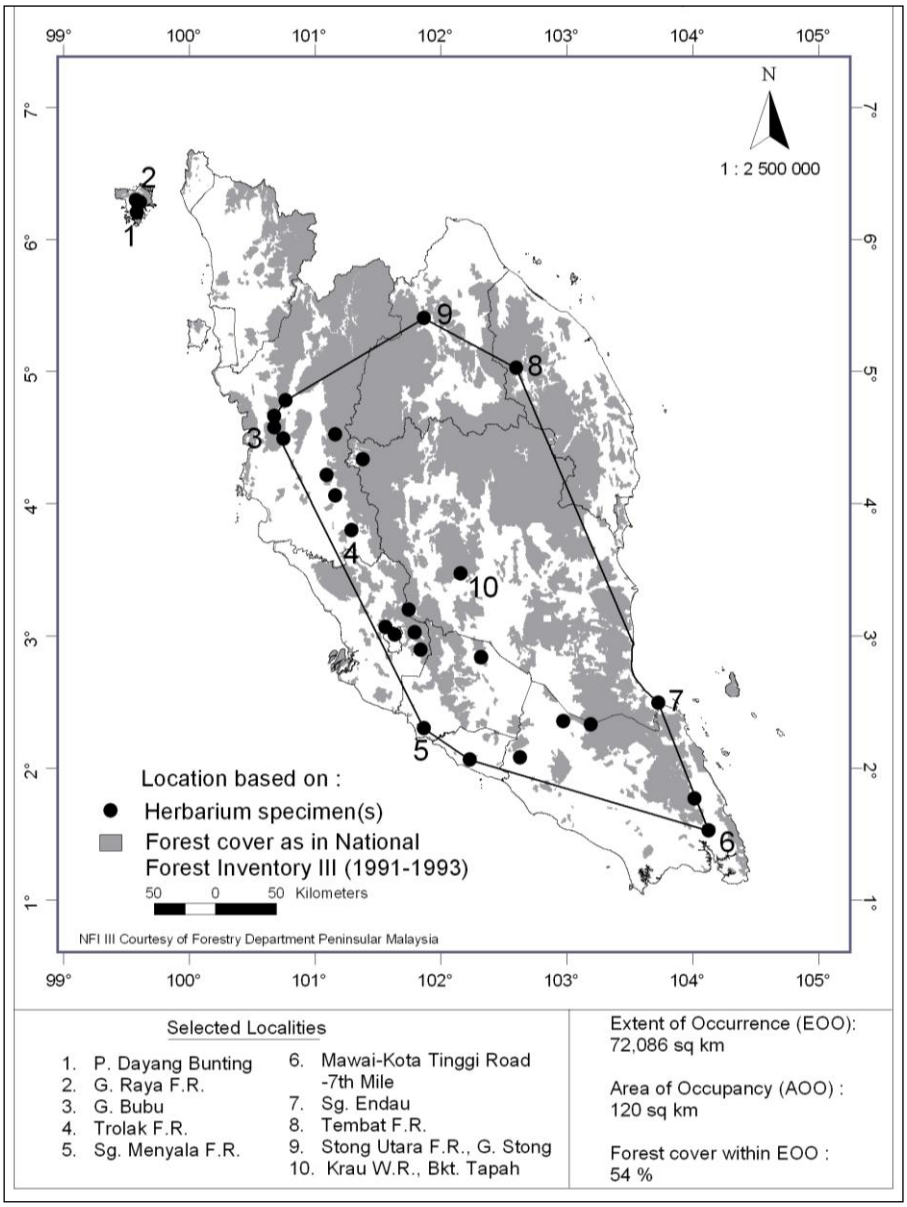
5.5.2 *Erycibe albida* **Map 5.2**

Conservation Status: Least Concern (LC)

Habitat and ecology: *Erycibe albida* grows both in the primary and secondary forests up to 820 m altitude. It is a shrub or treelet and is the most common species in the genus.

Locality: In Peninsular Malaysia, *Erycibe albida* is widespread and found in Johor, Kedah, Kelantan, Melaka, Negeri Sembilan, Pahang, Perak, Selangor and Terengganu (Map 5.2). In many localities *E. albida* occurs in forest reserves. It is not endemic and also occurs in Peninsular Thailand and Sumatra (Hoogland, 1953a; Staples, 2010).

Threats: No major threats were identified. In addition, several populations occur in the network of Totally Protected Areas.



Map 5.2. Geographical distribution of *Erycibe albida* in Peninsular Malaysia.

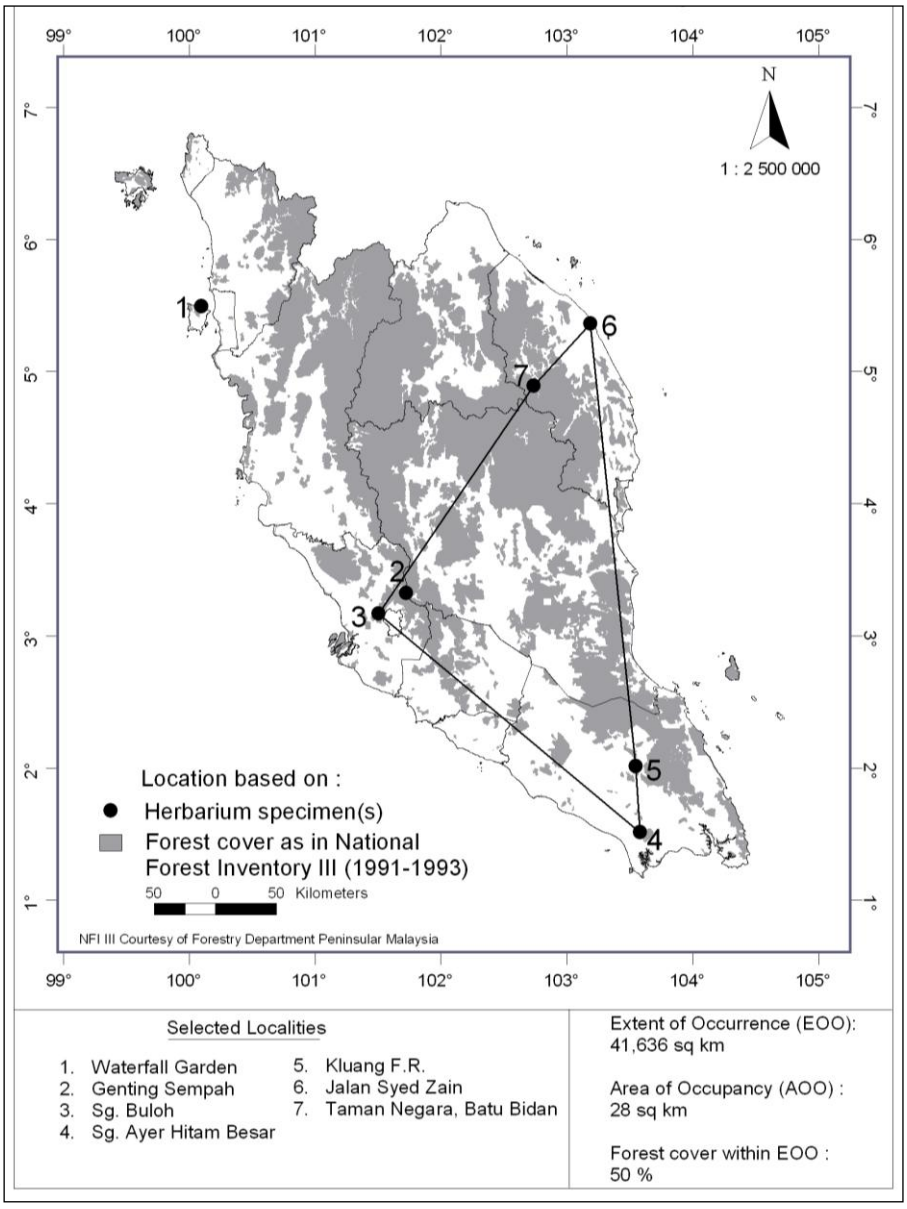
5.5.3 *Erycibe citriniflora* **Map 5.3**

Conservation Status: Least Concern (LC)

Habitat and ecology: *Erycibe citriniflora* grows at low altitudes both in the primary and secondary forests up to 300 m altitude, sometimes near rivers. It is a woody climber or a scrambling shrub.

Locality: In Peninsular Malaysia, *Erycibe citriniflora* is only found in a few localities in the states of Johor, Penang, Selangor and Terengganu (Map 5.3). In Terengganu and Johor, it occurs in the Batu Bidan National Park and Kluang Forest Reserve, respectively, which provide habitat stability. *Erycibe citriniflora* is not an endemic species and is also distributed in Peninsular Thailand and southern Myanmar (Hoogland, 1953a; Staples, 2010).

Threats: No major threats were identified. In general, all the habitats are stable and conservation measures are already in place for the habitat. For example, habitat protection is provided by various legislations related to Totally Protected Areas.



Map 5.3. Geographical distribution of *Erycibe citriniflora* in Peninsular Malaysia.

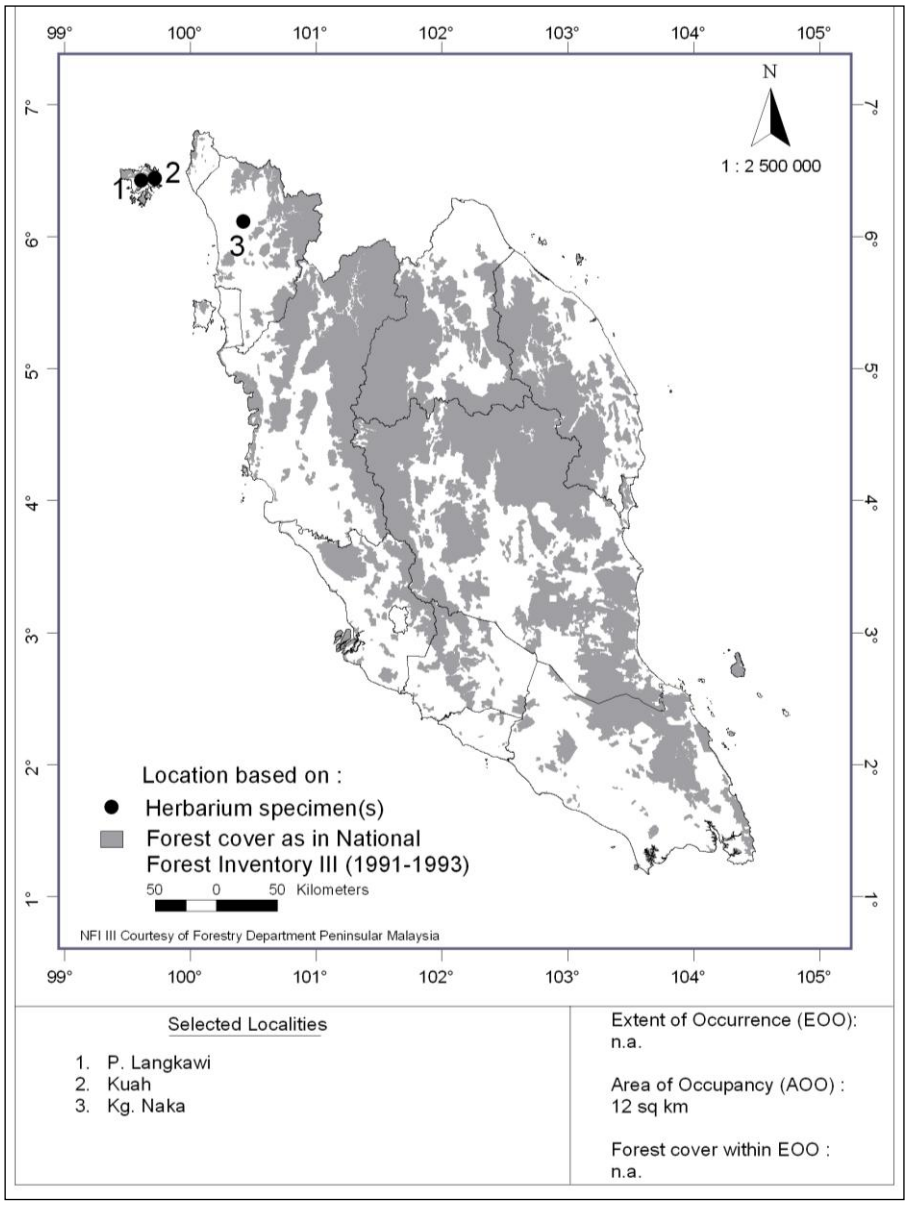
5.5.4 *Erycibe expansa* **Map 5.4**

Conservation Status: Near Threatened (NT)

Habitat and ecology: *Erycibe expansa* grows in secondary forest at low altitudes. It is a scandent shrub.

Locality: In Peninsular Malaysia, *Erycibe expansa* is only found in three localities and is confined to only one state, Kedah including Langkawi Island (Map 5.4). On Langkawi Island, it occurs in Kuah where the habitat is almost completely cleared for town development. *Erycibe expansa* is not an endemic species and also occurs in southern Myanmar, Peninsular Thailand, China (Yunnan) and probably also in the Nicobar Islands, India (Hoogland, 1953a; Staples, 2010).

Threats: The infrastructure development for human settlements and tourism/recreation in Langkawi Island are the major threats for the habitat of this species. The species was last collected from Langkawi Island in 1911. Its habitat has decreased due to the development undertaken in Kuah. On the mainland, the only collection was found in Kg. Naka, in 1933.



Map 5.4. Geographical distribution of *Erycibe expansa* in Peninsular Malaysia.

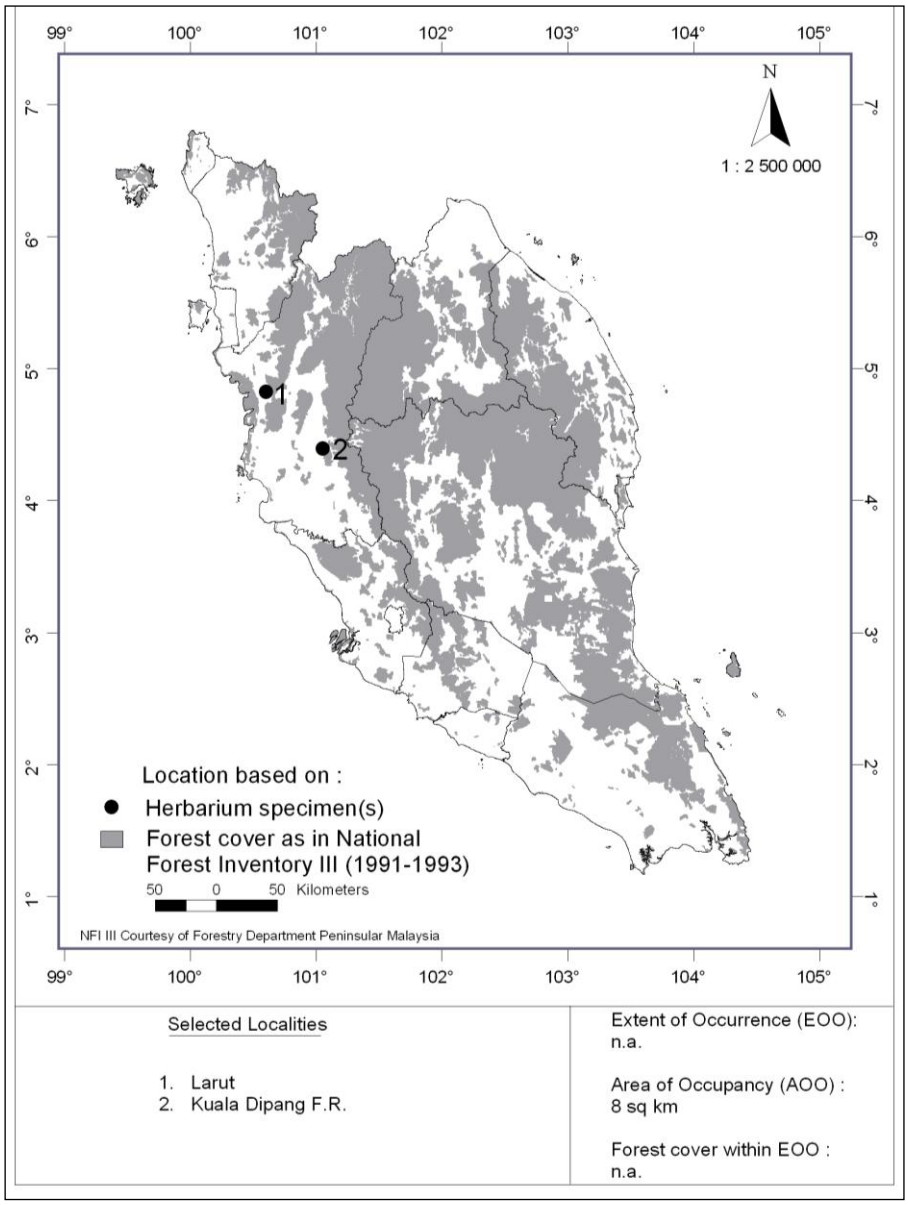
5.5.5 *Erycibe festiva* **Map 5.5**

Conservation Status: Endangered (EN) B1ab(iii)

Habitat and ecology: *Erycibe festiva* grows in open forest at low altitudes up to 200 m altitude. It is a creeper or scrambler reaching 20 m long.

Locality: In Peninsular Malaysia, *Erycibe festiva* is very rare and known from only two localities confined to the state of Perak (Map 5.5). The type collection was made in 1884 from Larut. The most recent collection was made from Kuala Dipang Forest Reserve in 1976. *Erycibe festiva* is not an endemic species and is also distributed in Banka Island and West Java, Indonesia (Hoogland, 1953a).

Threats: Infrastructure development for human settlements in Larut and Kuala Dipang threaten the species. Although it was found in forest reserves, the habitat information is not sufficient to confirm whether it occurs in protected areas. Nor are there ecological and population data available from the two collections and the last collection was made in 1976. Hence, field study within the population range and habitat status is needed for the areas from where the species was collected.



Map 5.5. Geographical distribution of *Erycibe festiva* in Peninsular Malaysia.

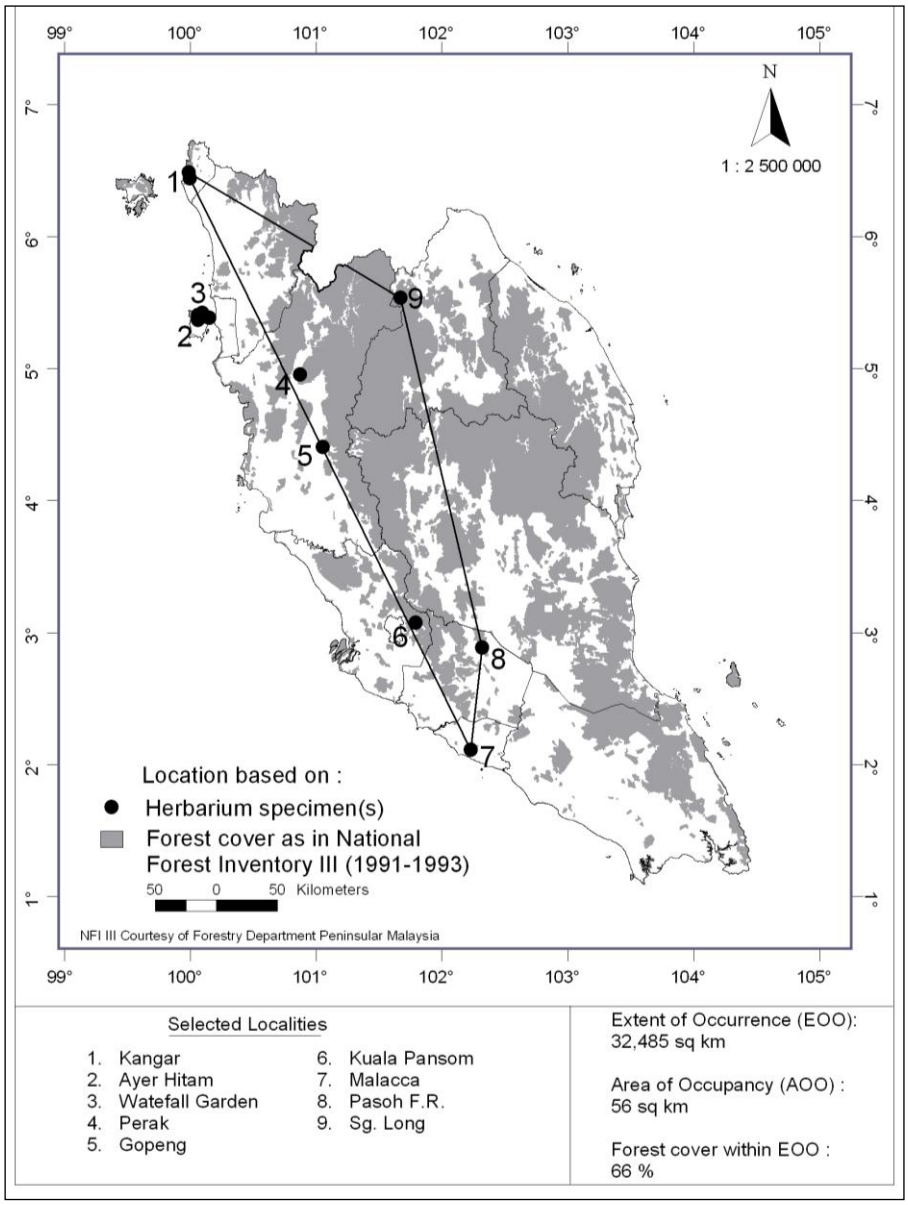
5.5.6 *Erycibe griffithii* **Map 5.6**

Conservation Status: Least Concern (LC)

Habitat and ecology: *Erycibe griffithii* usually grows in primary forest at low altitudes, but sometimes attains 900 m on Penang Hill. It is a creeper up to 24 m long or a scandent climber.

Locality: In Peninsular Malaysia, *Erycibe griffithii* is widespread and found in many localities in the states of Kelantan, Melaka, Negeri Sembilan, Penang, Perak, Perlis and Selangor (Map 5.6). Many collections were made from Penang Island especially around Penang Hill. Besides that, this species was also collected from Pasoh Forest Reserve, Negeri Sembilan, in 1996, and Taman Herba, Perlis, in 2000. *Erycibe griffithii* is not an endemic species and its distribution extends to India, southern Myanmar, Indo-China, Vietnam and Peninsular Thailand (Hoogland, 1953a; Nair, 1976; Staples, 2010).

Threats: Although *Erycibe griffithii* is categorized as LC, the developing infrastructure for roads on Penang Hill is a threat to the habitat of this species. From field survey made along the roadsides on top of Penang Hill in December 2009, not a single *E. griffithii* was observed. There were a number of roads being repaired due to landslides and new roads were being constructed. There is a possibility that some climbers along the roadsides had been cut down due to the constructions work.



Map 5.6. Geographical distribution of *Erycibe griffithii* in Peninsular Malaysia.

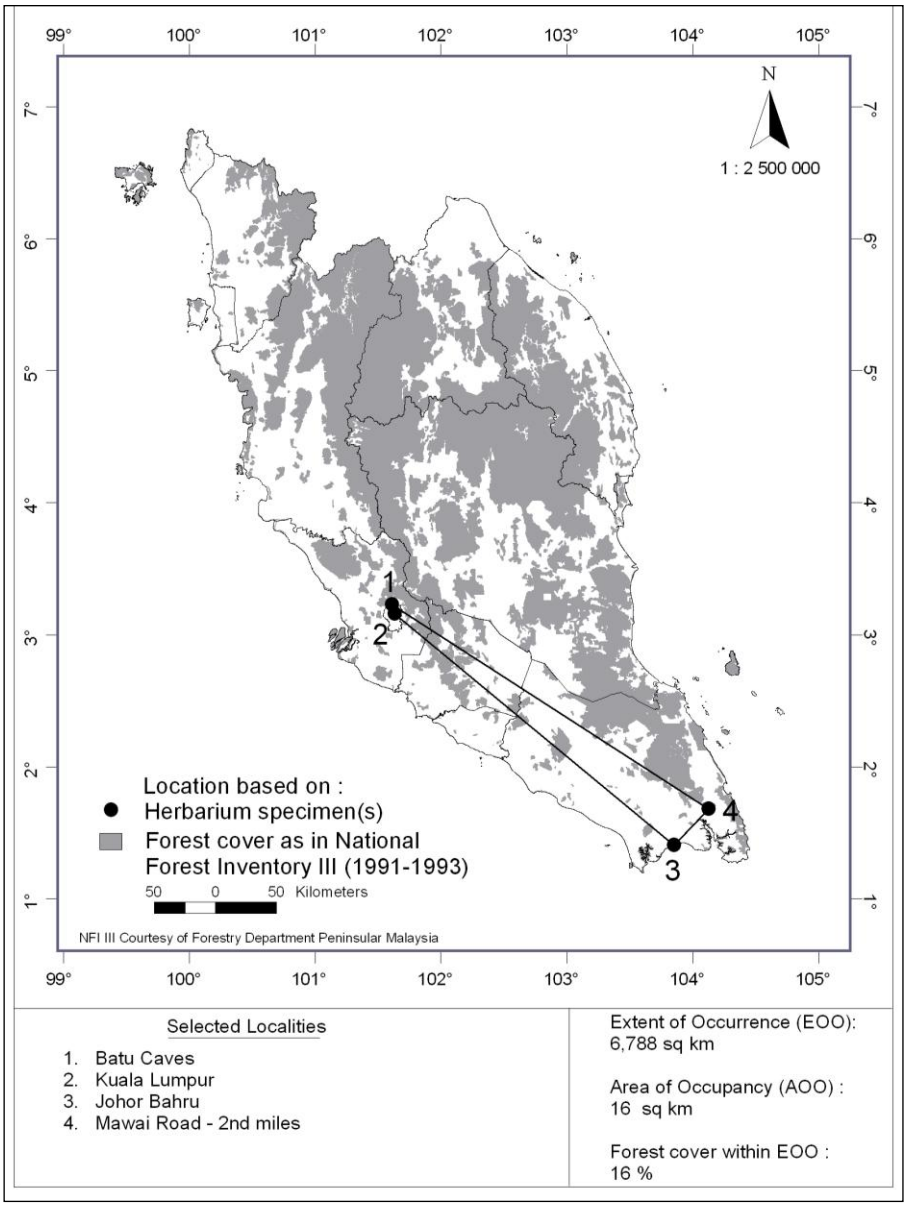
5.5.7 *Erycibe leucoxyloides* **Map 5.7**

Conservation Status: Vulnerable (VU) A2c

Habitat and ecology: *Erycibe leucoxyloides* usually grows in open country or on roadsides at low altitudes. It is a slender, low, bushy climber.

Locality: In Peninsular Malaysia, *Erycibe leucoxyloides* has been found only from four localities confined to the states of Johor and Selangor (Map 5.7). The latest collection was recorded from Mawai road, Kota Tinggi, in 1930. It is not a common species in Peninsular Malaysia. The species is not endemic and also occurs in Singapore; a specimen in the Singapore Herbarium was collected in 2005 from Nee Soon Pipeline, Singapore.

Threats: *Erycibe leucoxyloides* has a threatened category, VU, because the population is only known from four localities, and none of which is in a protected area. Population reduction has been estimated in Johor Bahru and Batu Caves where the causes of reduction may not have ceased or may not be reversible. These areas are undergoing rapid development for human settlements and towns which caused populations reduction. Although there is no longer quarrying activities occur at Batu Caves, the infrastructure development surrounding the area associated with the Hindu Temple that is responsible for the declining habitat quality. Therefore, the habitat status for Batu Caves requires checking. *Erycibe leucoxyloides* has recently been collected from Singapore in 2005, but it is quite a surprise that the species has not been collected from Peninsular Malaysia since 1930. Little information was obtained from the specimen labels but it is believed that the species occurs near roadsides or very open areas as collections were from Kuala Lumpur, Batu Caves, Johor Bahru and Mawai Road, Kota Tinggi.



Map 5.7. Geographical distribution of *Erycibe leucoxyloides* in Peninsular Malaysia.

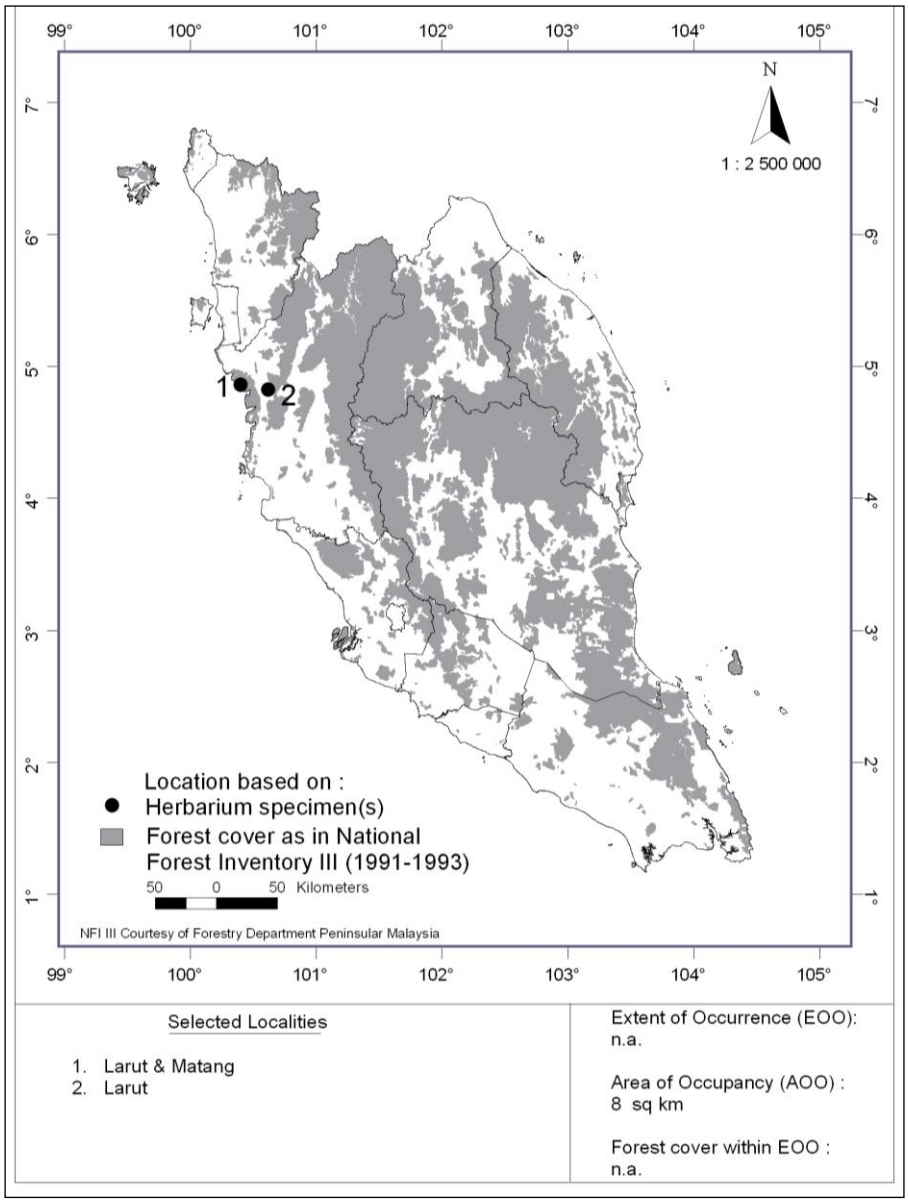
5.5.8 *Erycibe magnifica* **Map 5.8**

Conservation Status: Data Deficient (DD)

Habitat and ecology: *Erycibe magnifica* is reported from open or dense forest up to 330 m altitude. It is a strong, slender creeper or climber clinging on large trees.

Locality: In Peninsular Malaysia, *Erycibe magnifica* is very rare and found only in two localities confined to the state of Perak (Map 5.8). It is endemic to Peninsular Malaysia (Hoogland, 1953a).

Threats: *Erycibe magnifica* is categorized as DD. The status of the species cannot be assessed because the species has not been collected since 1883. The few places in Larut and Larut Matang from where it was collected, are now has been transformed to human settlement areas that threatened its habitat. In addition, the habitat information on old herbarium specimens has very little ecological and population data available. Thus, there is no suitable category to be given for the species due to lack of data.



Map 5.8. Geographical distribution of *Erycibe magnifica* in Peninsular Malaysia.

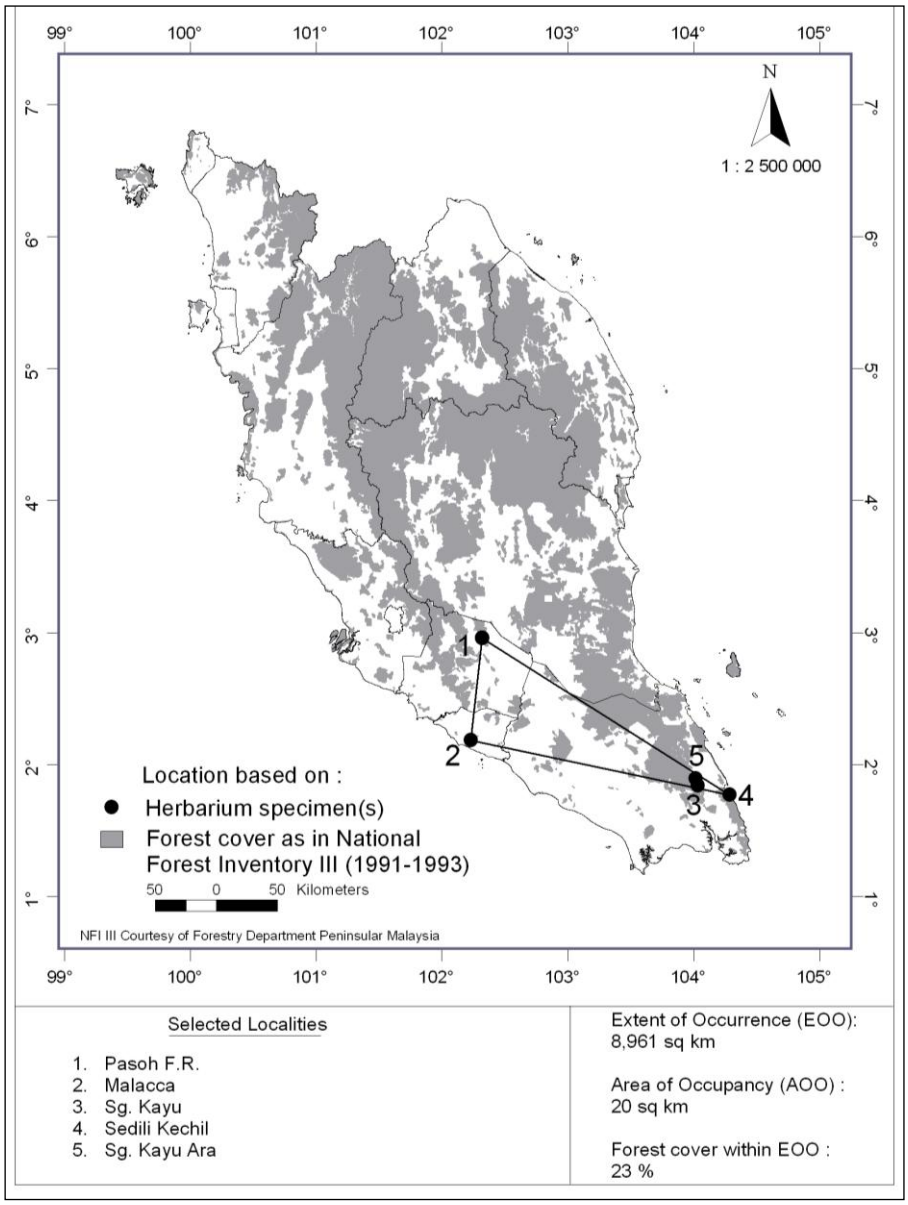
5.5.9 *Erycibe maingayi* **Map 5.9**

Conservation Status: Least Concern (LC)

Habitat and ecology: *Erycibe maingayi* grows in forest up to 120 m, along roads and on forest margins. It is a scandent climber or a liana.

Locality: In Peninsular Malaysia, *Erycibe maingayi* is found in the states of Johor, Melaka and Negeri Sembilan (Map 5.9). It has been found a few times at Pasoh Forest Reserve research plot. It is not an endemic species and its distribution extends to Sumatra and Borneo (Kinabalu, Sabah) (Hoogland, 1953a).

Threats: In general, there are no major threats to its habitats. The quality of its habitat is stable and it is also present in a research forest at Pasoh Forest Reserve.



Map 5.9. Geographical distribution of *Erycibe maingayi* in Peninsular Malaysia.

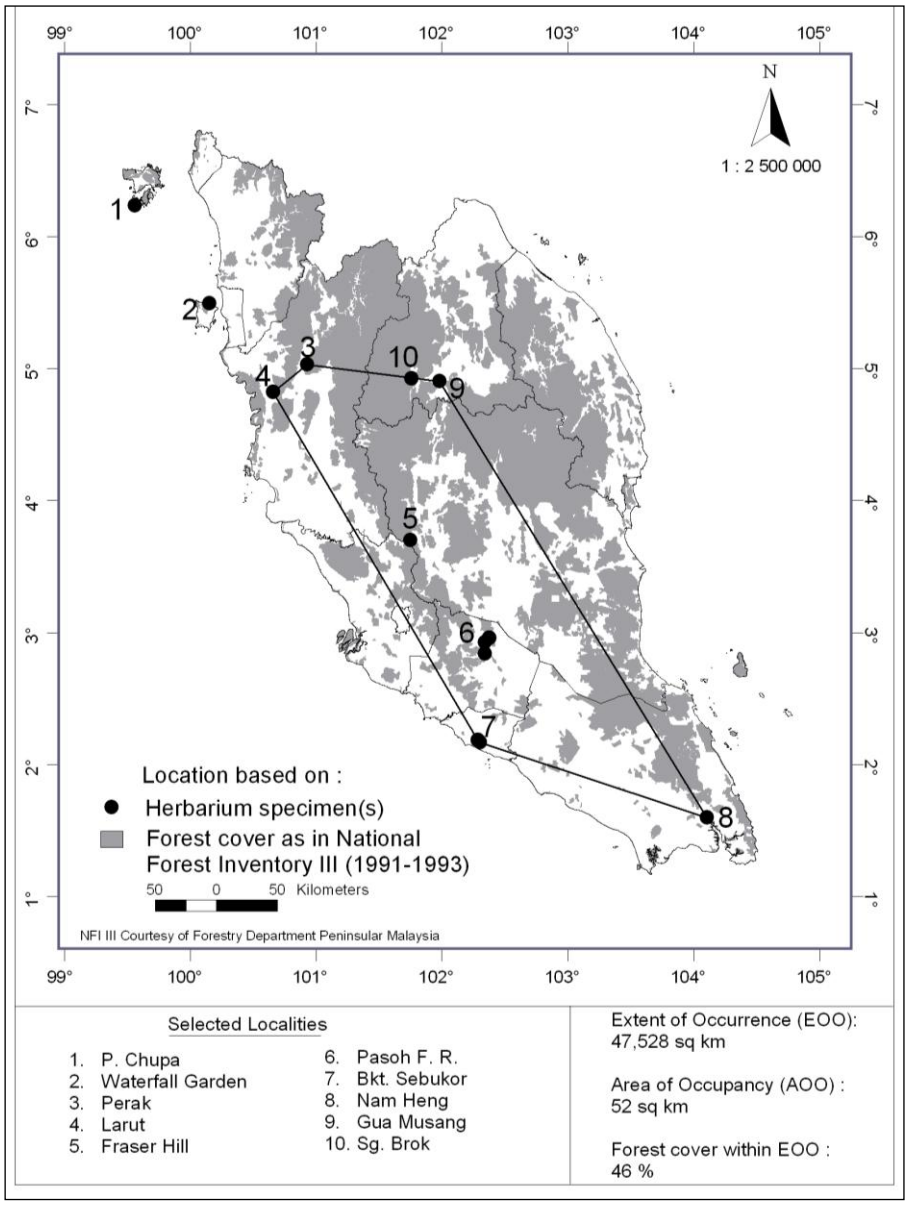
5.5.10 *Erycibe malaccensis* **Map 5.10**

Conservation Status: Least Concern (LC)

Habitat and ecology: *Erycibe malaccensis* grows in the primary and secondary forests from low altitudes to 1200 m. It is a creeper or a climber.

Locality: *Erycibe malaccensis* is widespread in Peninsular Malaysia. It is found in Johor, Kedah (Langkawi), Kelantan, Melaka, Negeri Sembilan, Pahang, Penang and Perak (Map 5.10). It is common in the Pasoh Forest Reserve research plot. It is not endemic and is also distributed in the Myanmar, Philippines, Celebes and probably also in west Java, Indonesia (Hoogland, 1953a; John Kress *et al*., 2003).

Threats: In general, there are no major threats to its habitats and populations. The quality of habitats is stable and in addition the species is present in a research forest. The species is used in small amounts by local people as a medicine (Burkill, 1966).



Map 5.10. Geographical distribution of *Erycibe malaccensis* in Peninsular Malaysia.

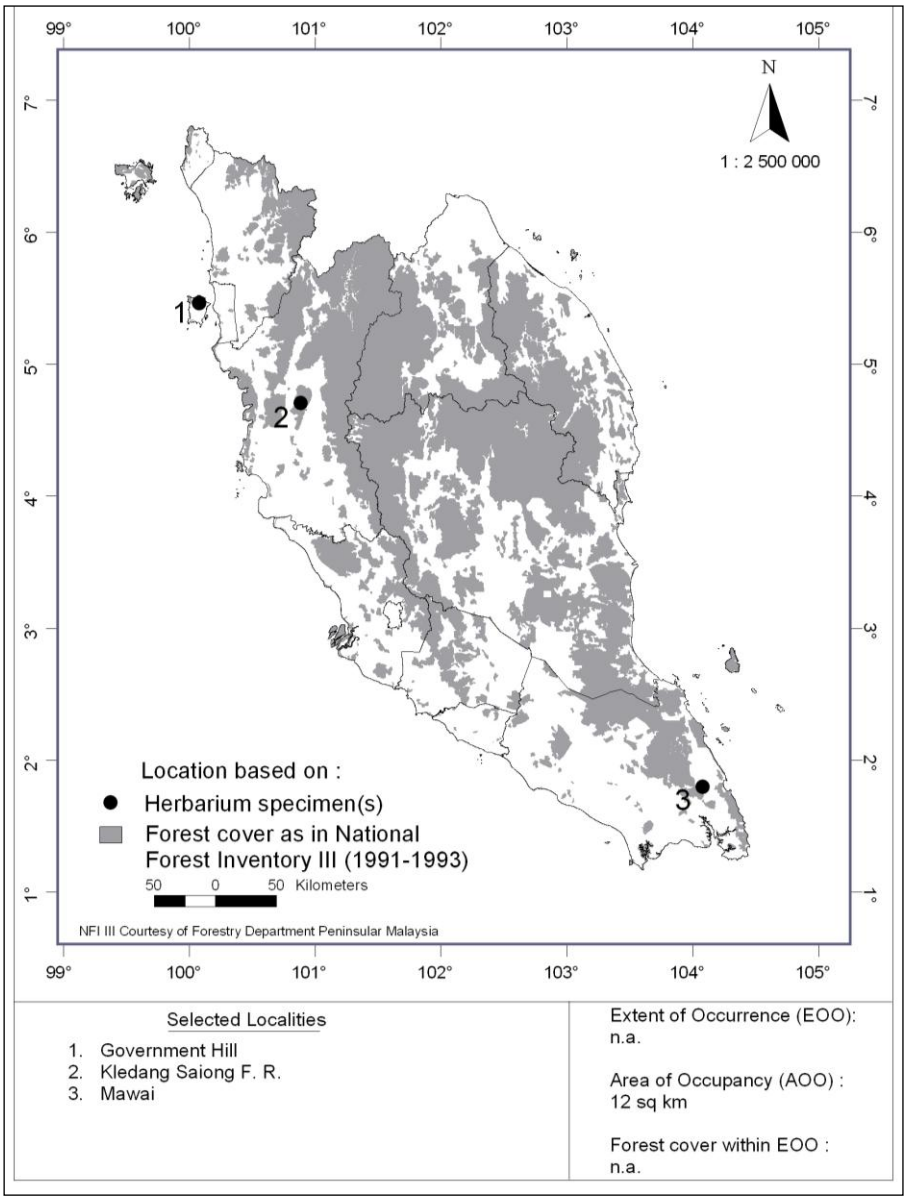
5.5.11 *Erycibe praecipua* ssp. *praecipua* **Map 5.11**

Conservation Status: Vulnerable (VU) A2c

Habitat and ecology: *Erycibe praecipua* ssp. *praecipua* grows in the primary and secondary forests from 150 to 600 m altitude. It is a climber or a large climbing shrub.

Locality: *Erycibe praecipua* ssp. *praecipua* is found only in three localities in Johor, Penang and Perak (Map 5.11). It is not a common taxon and is endemic to Peninsular Malaysia, while *E. praecipua* ssp. *borneensis* is endemic to Borneo (Hoogland, 1953a).

Threats: *Erycibe praecipua* ssp. *praecipua* is categorized as VU because the population reduction has been estimated, which may not be reversible. For example, an activity such as development for human settlements on Government Hill, Penang, threatens the taxon. Several forested areas were cleared or are being cleared to build houses and new roads. All the activities mentioned may alter the landscape by removal of hedges and forest fringes which are known as the habitats for the species. In Perak, it occurs in Kledang Saiong Forest Reserve and probably occurs in a secondary forest in Mawai, Johor. However, it has not been collected since 1934.



Map 5.11. Geographical distribution of *Erycibe praecipua* ssp. *praecipua* in Peninsular Malaysia.

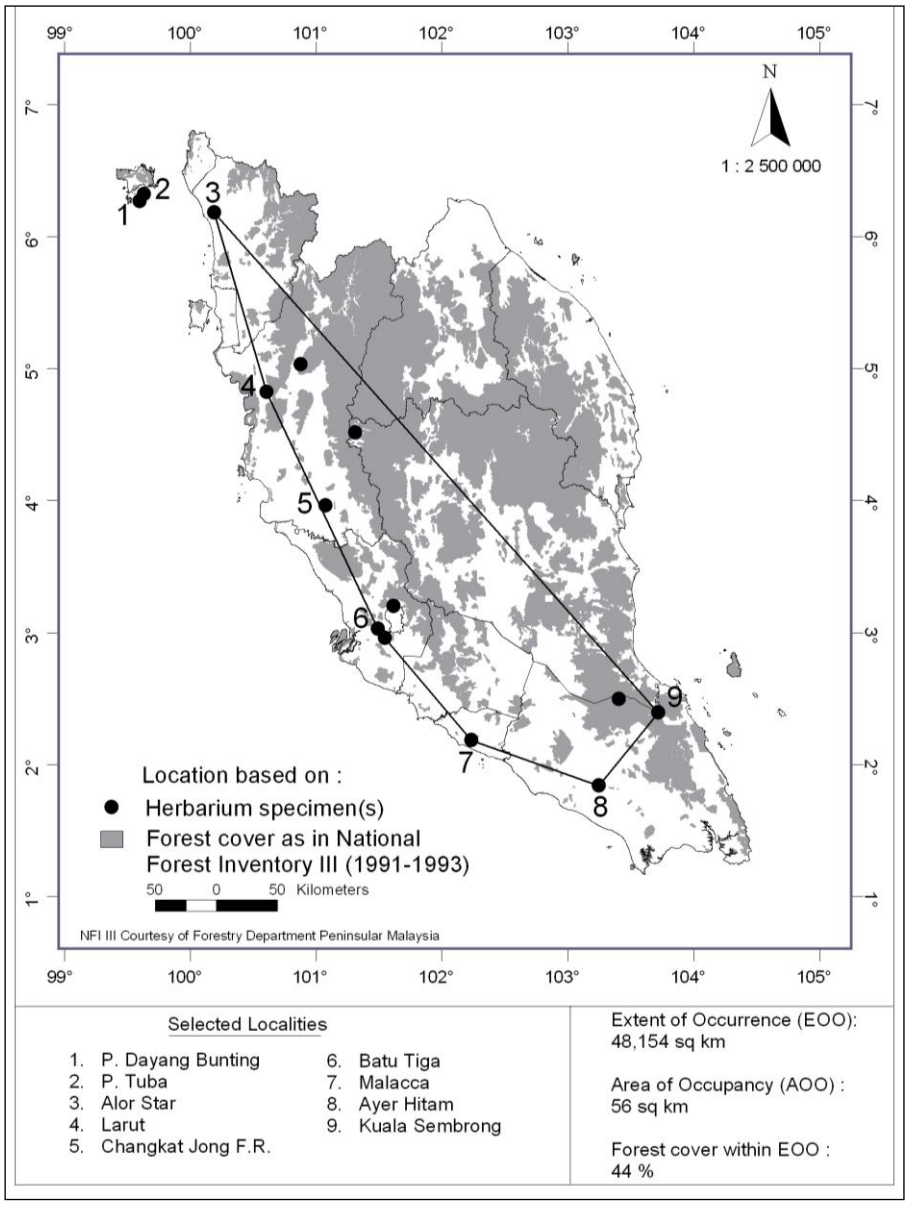
5.5.12 *Erycibe rheedii* **Map 5.12**

Conservation Status: Least Concern (LC)

Habitat and ecology: *Erycibe rheedii* grows usually in secondary forest to 240 m altitude. It is a large climber or a creeper.

Locality: *Erycibe rheedii* has a widespread distribution from Johor, Kedah, Melaka, Pahang (Cameron Highlands), Perak and Selangor (Map 5.12). It is common and not endemic to Peninsular Malaysia. *Erycibe rheedii* is also occures in Sumatra, West Java, Indonesia, and Borneo (Sabah) (Hoogland, 1953a).

Threats: No major threat to the habitat and populations was identified. The species also occurs in secondary forest. The species is used only in small amounts by local people as a medicine (Burkill, 1966).



Map 5.12. Geographical distribution of *Erycibe rheedii* in Peninsular Malaysia.

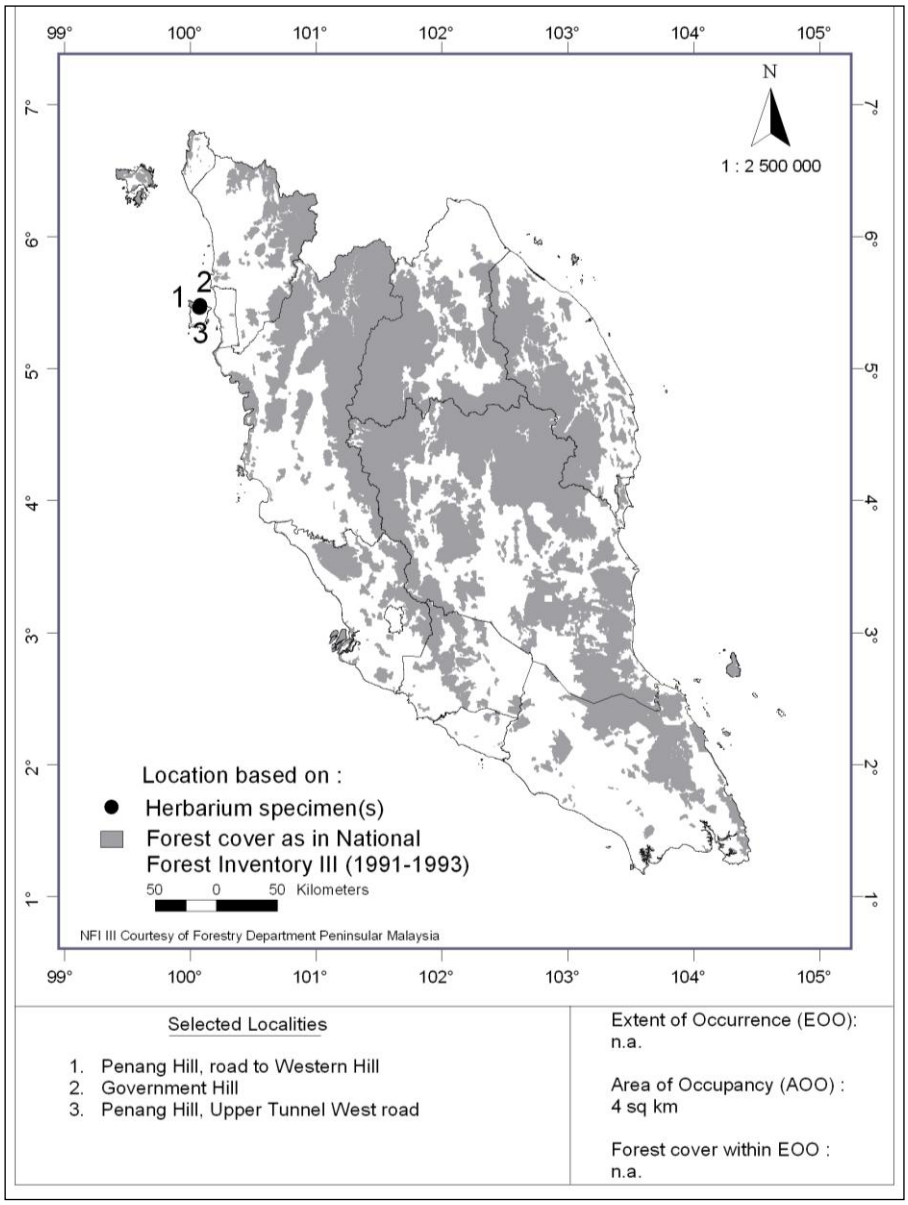
5.5.13 *Erycibe sapotacea* **Map 5.13**

Conservation Status: Endangered (EN) A4c

Habitat and ecology: *Erycibe sapotacea* grows near roadsides and in open areas, up to 760 m altitude. It is a scandent shrub or a large woody climber.

Locality: *Erycibe sapotacea* is known only from Penang (Map 5.13). It is endemic to Peninsular Malaysia (Hoogland, 1953a).

Threats: *Erycibe sapotacea* is considered as EN because its population is estimated to have declined on Penang Hill. Penang Hill has been a popular holiday destination, hence development of infrastructures, such as new roads and bungalows were actively carried out. These activities which may not have ceased and still threaten the habitat of this species. The species was recently collected from the roadside but only one plant/individual was observed. It occurs in the non-protected area on Penang Hill and if the present road is widened, the climbers will be cleared. However, it also occurs on Government Hill (northern part of Penang Hill), where the area is designated as a water catchment area and no development is permitted.



Map 5.13. Geographical distribution of *Erycibe sapotacea* in Peninsular Malaysia.

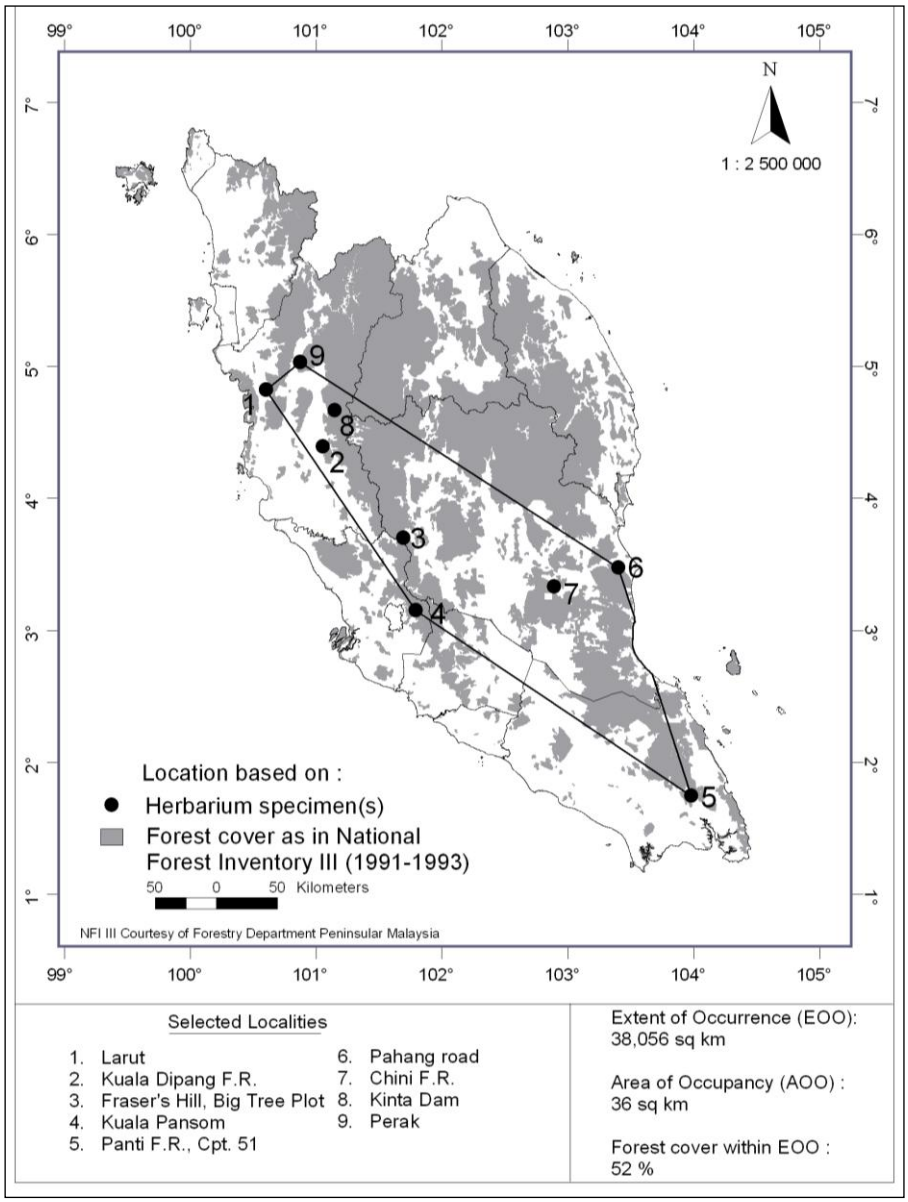
5.5.14 *Erycibe stapfiana* **Map 5.14**

Conservation Status: Least Concern (LC)

Habitat and ecology: *Erycibe stapfiana* grows in dense forest up to 1200 m altitude. It is a creeper or a climber of the forest canopy.

Locality: *Erycibe stapfiana* is distributed from Johor, Pahang, Perak and Selangor (Map 5.14). It is not endemic to Peninsular Malaysia and its distribution extends to Peninsular Myanmar (Brandis, 1906; Hoogland, 1953a; John Kress *et al*., 2003).

Threats: There are no major threats to its habitats and populations. The species has a fairly widespread distribution and was collected recently in a dense forest at Kinta Dam Forest Reserve, Perak.



Map 5.14. Geograhical distribution of *Erycibe stapfiana* in Peninsular Malaysia.

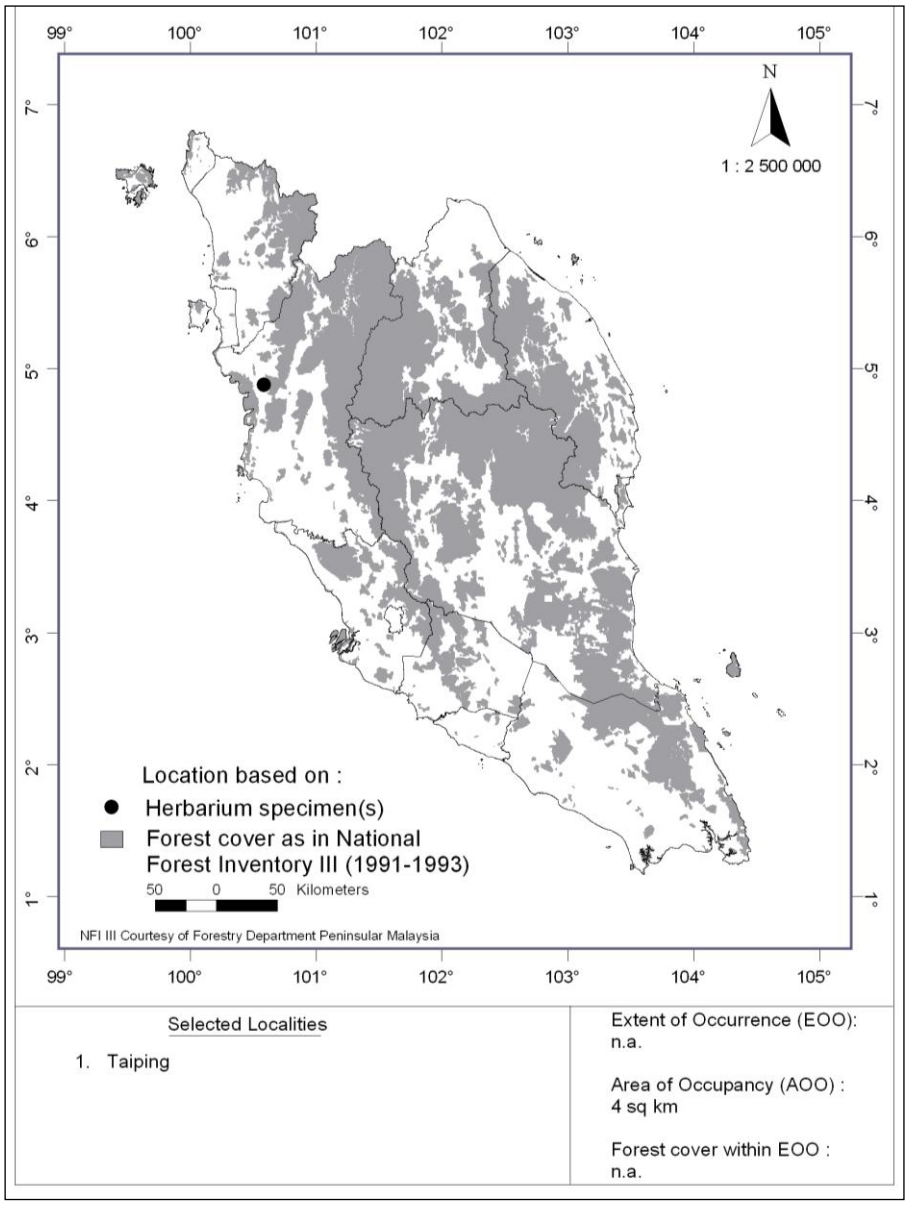
5.5.15 *Erycibe strigosa* **Map 5.15**

Conservation Status: Data Deficient (DD)

Habitat and ecology: *Erycibe strigosa* was reported to grow in dense forest from 150 to 240 m altitude. It is a creeper, clinging to trees.

Locality: *Erycibe strigosa* was collected only once from Taiping, Perak, in 1886 and never seen alive again (Map 5.15). It is endemic to Peninsular Malaysia (Hoogland, 1953a). Information on the habitat and population from the single known locality is not comprehensive therefore very limited; no ecological and population data are available. A research study on the habitat and population range is required. Thus, status of the species cannot be assessed because no recent collection has been made. At present, there no suitable category can be given for the species.

Threats: Human settlement around Taiping may threaten to the habitat status.



Map 5.15. Geographical distribution of *Erycibe strigosa* in Peninsular Malaysia.

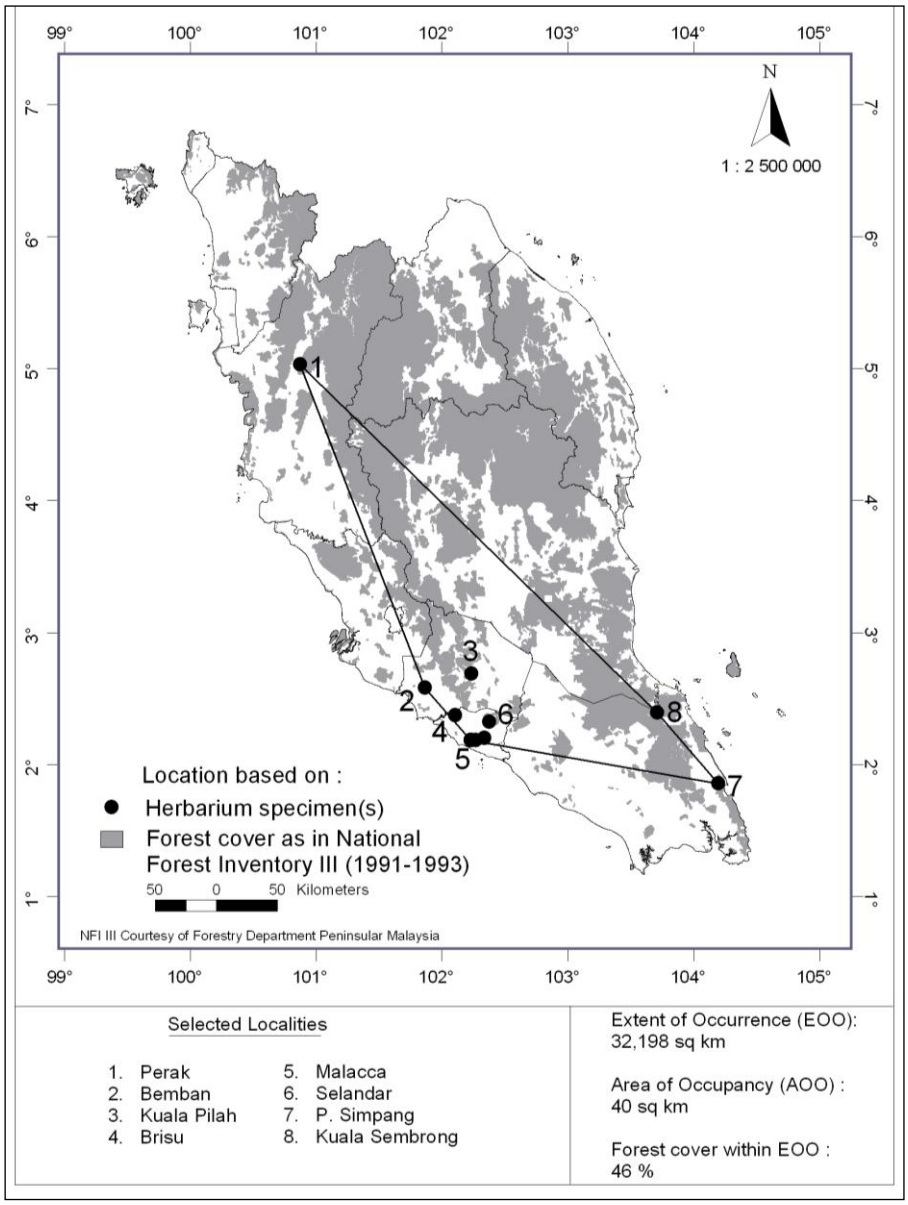
5.5.16 *Erycibe tomentosa* var. *tomentosa* **Map 5.16**

Conservation Status: Least Concern (LC)

Habitat and ecology: *Erycibe tomentosa* var. *tomentosa* grows in secondary forest at low altitudes. It is a creeper climber.

Locality: *Erycibe tomentosa* var. *tomentosa* is known from Johor, Melaka, Negeri Sembilan and Perak (Map 5.16). It is not endemic to Peninsular Malaysia and is also distributed in Sumatra, West Java, Madura, Borneo and the Philippines (Hoogland, 1953a).

Threats: Generally, there are no major threats to its habitats and populations. Most of the specimens are found in secondary forest and the distribution is fairly widespread.



Map 5.16. Geographical distribution of *Erycibe tomentosa* var. *tomentosa* in Peninsular Malaysia

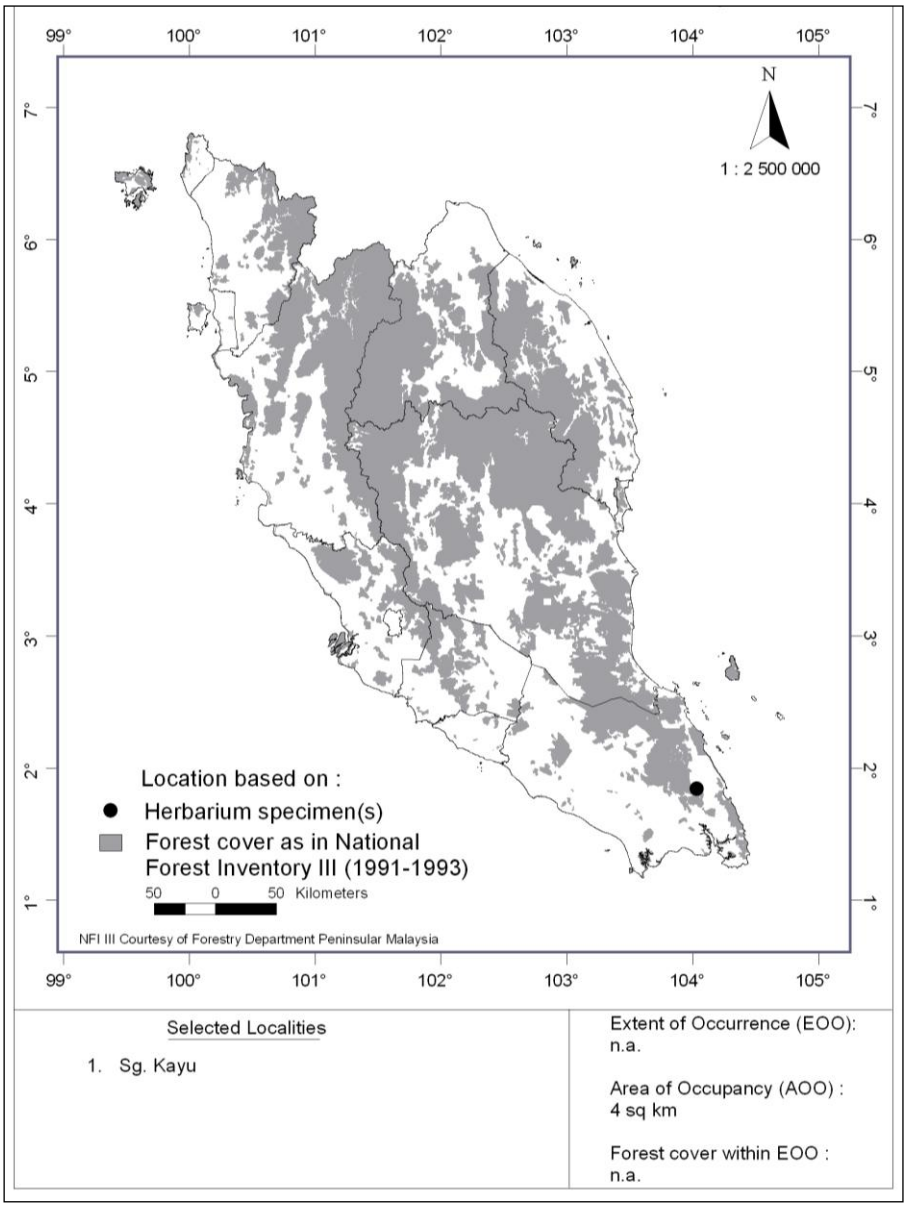
5.5.17 *Erycibe tomentosa* var. *hirsuta* **Map 5.17**

Conservation Status: Critically Endangered (CR) B2ab(iii)

Habitat and ecology: *Erycibe tomentosa* var. *hirsuta* grows at low altitudes in swampy areas. It is a climber.

Locality: *Erycibe tomentosa* var. *hirsuta* is known only from Sg. Kayu, Kota Tinggi, Johor (Map 5.17). It is not endemic to Peninsular Malaysia but is also distributed in Sumatra, Singapore and Borneo (Hoogland, 1953a).

Threats: *Erycibe tomentosa* var. *hirsuta* is considered as CR because it is known only from a single locality that is outside the network of Totally Protected Areas. There are two threats recognized. First, the development of the area for small-scale agro-forestry or oil palm plantations. Second, the development of infrastructures for human settlement and land transportation such as new roads building. The species has not been collected since 1952 and has a high risk of extinction in the wild. Therefore, a study on the population range, size and viability is needed.



Map 5.17. Geographical distribution of *Erycibe tomentosa* var. *hirsuta* in Peninsular Malaysia.

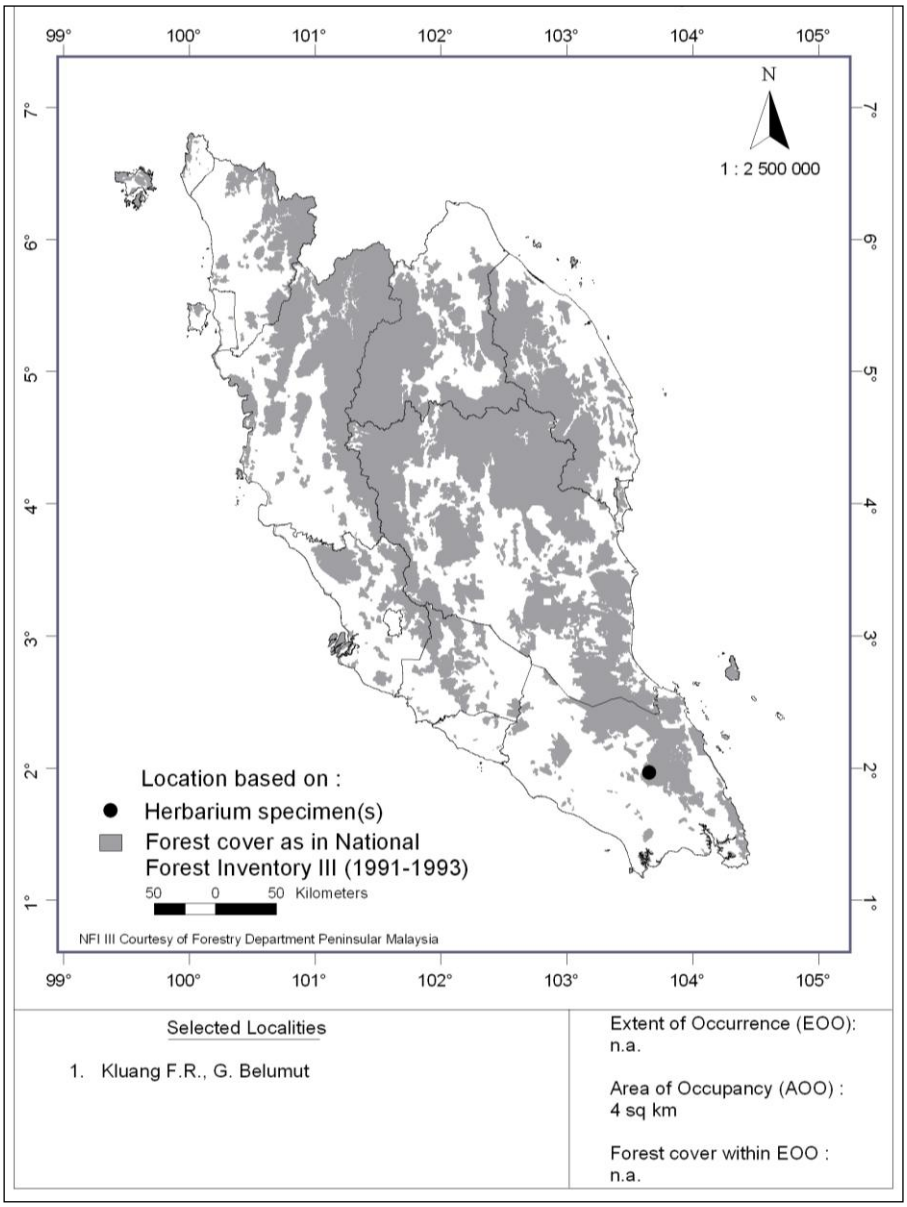
5.5.18 *Erycibe* sp. A **Map 5.18**

Conservation Status: Not Evaluated (NE)

Habitat and ecology: *Erycibe* sp. A grows in forest at 500 m altitude. It is a woody climber.

Locality: *Erycibe* sp. A is known from a single locality in the Gunung Belumut Forest Reserve, Johor (Map 5.18).

Threats: The species has not yet been published because the material is not sufficient to describe it scientifically as a new species. Therefore, its conservation status is not evaluated until more information is obtained.



Map 5.18. Geographical distribution of *Erycibe* sp. A in Peninsular Malaysia.

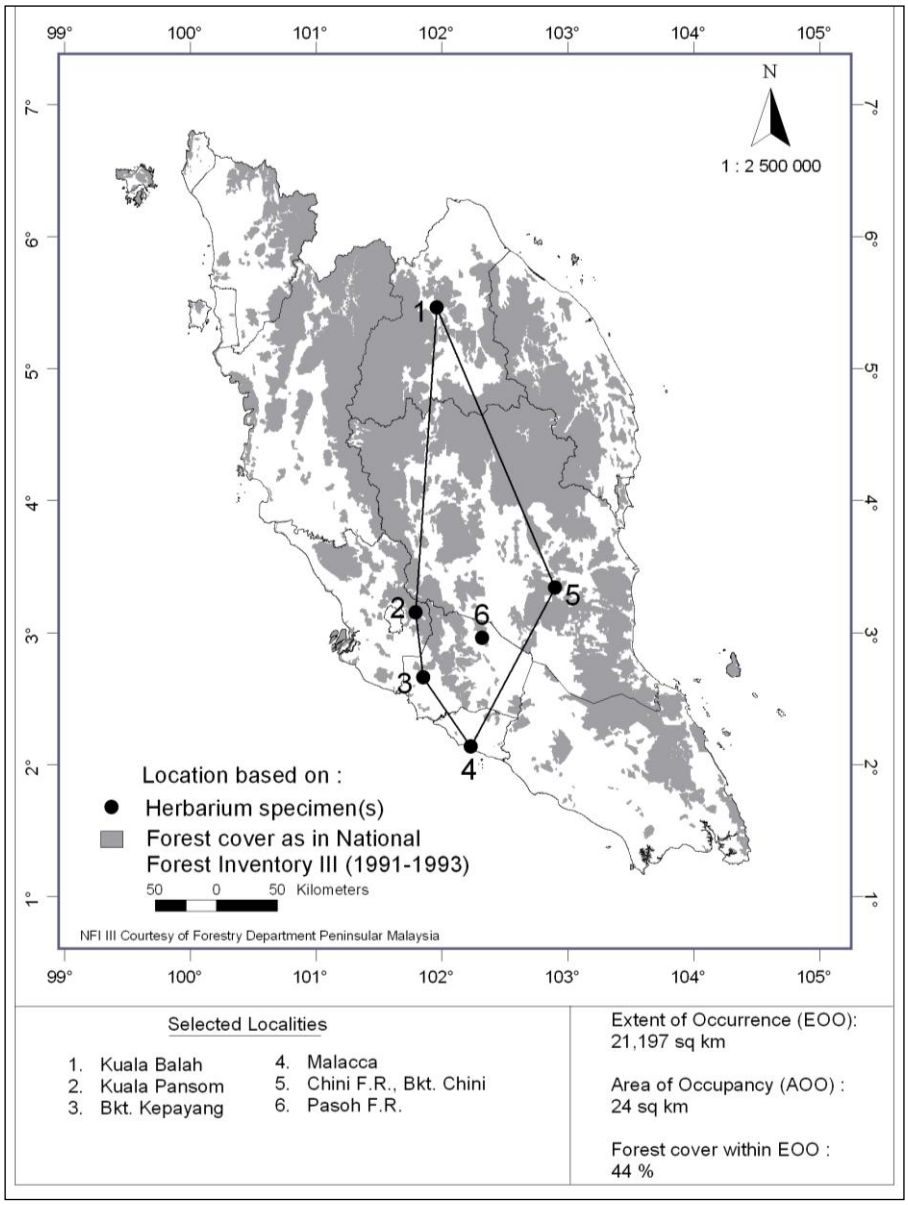
5.5.19 *Erycibe* sp. B **Map 5.19**

Conservation Status: Not Evaluated (NE)

Habitat and ecology: *Erycibe* sp. B grows in lowland forest. It is a woody climber.

Locality: *Erycibe* sp. B is known from Kelantan, Melaka, Negeri Sembilan, Pahang and Selangor (Map 5.19).

Threats: The species is not yet published because none of the specimens have matured flowers. The species will not be evaluated until more information is obtained that enables it to be described as a new species.



Map 5.19. Geographical distribution of *Erycibe* sp. B in Peninsular Malaysia.

5.6 Discussion and conclusions

Historically, lianas and climbers were neglected as a focus of study for some biologists, taxonomists or plant collectors. One of the reasons is liana have less economic importance compared to timber trees such as dipterocarp group. In addition, it is not easy to identify and collect samples in the field as many lianas or climbers often high in the forest canopy. Moreover, they are often overlooked when not flowering.

During this study, five species of *Erycibe* were successfully rediscovered and collected. Besides getting the fertile samples, it is important to identify and record the population sizes in TDIS form. *Erycibe* species are difficults to identify in the field when not in flower so they are frequently overlooked. Field character, such as bark surface, is just an additional character to identify the genus, however, more morphological characters are required to confirm the species identification.

Erycibe aenea was recently found along a logged-over forest during field trip to Tenggaroh Forest Reserve, Johor, in September 2010. It is a scrambling liana and fruit samples were collected from a fallen tree. It is believed that its population size was larger but they could not be seen since they climb up to the tree canopy.

Erycibe albida was found flowering at Temurun Waterfall in Kedah on a hillside. It has quite a scattered distribution with more than seven plants found distributed on the hillside. In Pasoh Forest Reserve, Negeri Sembilan, it occurs in a research plot whereas in Tembat Forest Reserve, Terengganu, it is scattered in logged-over forest. All collections were made on lowland areas from 50 to 270 m altitude.

Erycibe sapotacea, a narrowly endemic species, was found only on Penang Hill which is the type locality. However, only a single plant was observed along the Upper Tunnel West Road during the field study. This climber occurs in a non-protected area and

close to private bungalows. It was fruiting in December 2009, however, the plant was still not flowering when another survey was conducted in October 2010.

Erycibe stapfiana, a big liana reaching about 30 to 35 m tall in the forest canopy, was observed flowering in April 2010 at 500 m altitude, on the trail to Gunung Korbu in Perak. The liana produces many flowers, lasting only 2 to 3 weeks. Only two populations were found along the trail to Gunung Korbu. The first population is on a hillside and the second population is near a saraca river, with quite an open forest canopy.

Erycibe rheedii is quite common on Pulau Tuba, Kedah, near Gua Wang Buluh (a limestone cave). More than 15 plants were found along the trail to the cave's base. Through several visits at the habitat, it only flowers once a year, in early March, and the fruiting season is towards the end of that month (personal observations).

Table 5.1 is a summary of the conservation status of 19 taxa of *Erycibe* in Peninsular Malaysia. Nine taxa (47.4%) are categorized as LC, one taxa (5.3%) as NT, two taxa (10.5%) as VU, two (10.5%) taxa as EN, one taxa (5.3%) as CR and two taxa (10.5%) as DD. The two undescribed taxa (*E.* sp. A and *E.* sp. B), are not evaluated (NT), represented 10.5%. Peninsular Malaysia has 19 recognized taxa of which four taxa are endemic (excluding undescribed taxa) namely *E. magnifica*, *E. praecipua* ssp. *praecipua*, *E. sapotacea* and *E. strigosa*. Of the five threatened taxa, two are endemic to Peninsular Malaysia: *E. praecipua* ssp. *praecipua* and *E. sapotacea*. *Erycibe magnifica* and *E. strigosa* are endemic species categorized as DD due to the very limited information available such as precise collection sites and size of populations. Both species (*E. magnifca* and *E. strigosa*) are present only in Perak. In Peninsular Malaysia, the main threat to all threatened taxa is land use changes caused from either town or human settlement development or land use for plantations.

Penang Hill itself is home to at least three species and one subspecies namely *E. malaccensis*, *E. grifithii*, *E. sapotacea* and *E. praecipua* ssp. *praecipua*. Although there is a legal protection of the forest on Penang Hill, which is actually only at Government Hill, many *Erycibe* species grow in unprotected areas such as roadsides or on private land. Therefore, once these areas developed e.g. for private bungalows or new roads, all the areas will be cleared and this will especially affect climbers. So, there is an issue and conflict of clearing land for the development or maintaining the climbers. Fortunately, the two species *E. malaccensis* and *E. griffithii* are categorized as LC because they are found elsewhere. However, both *E. sapotacea* and *E. praecipua* ssp. *praecipua* have a threatened category that needs extra effort in saving and protecting their habitat. As shown, *E. sapotacea* is a species with narrow geographical range, endemic to Penang Hill and considered as EN, whereas *E. praecipua* ssp. *praecipua* which is considered as VU, which is not been collected from Penang Hill since 1890 need to be relocated.

Erycibe sp. A is believed to be endemic to Gunung Belumut, Johor, and it is located within a forest reserve, which has conservation protection. A few visits were conducted to Gunung Belumut but unsuccessful to relocate the species due to very limited habitat and lack precise locality information. Therefore, it is vital to record detail locality during collecting sample so that easier to relocate the plants in the future. *Erycibe* sp. B, is endemic to lowland forest in Pahang, Selangor and Negeri Sembilan, including Pasoh Forest Reserve, which is a research forest and relatively undisturbed. Due to the limited information on the localities, ecology and population data, the two unpublished *Erycibe* species are not evaluated until more information is available.

Schnitzer & Bongers (2002), studied ecology of liana in the tropics, reported that lianas are expected to become abundant as the rate of tropical forest disturbance increases. Liana abundance, however, varies with several key abiotic factors including total rainfall,

seasonality of rainfall, soil fertility and disturbance. However, all these factors need long-term studies and as yet none exists for *Erycibe* species. Moreover, studies on the ecology, plant behaviour, pollination and seed predation are also needed for *Erycibe* species to give an idea at least on the population and distribution patterns which is very important aspect in the conservation assessment.

From the *ex situ* aspect, there are efforts in bringing seedlings from Pasoh Forest Reserve (Negeri Sembilan), Temurun Waterfall (Kedah) and Penang Hill (Penang), for trial planting in the FRIM nursery. However, after about two weeks, the seedlings died and only one individual from Pasoh Forest Reserve survived but still has not flowered after more than one year in the nursery. *Erycibe* seedling is a very slow grower with the height of the climber is not showing rapid growth (personal observation). Corroborating this, during a field survey at Pulau Ubin, Singapore in 2009, a French horticulturist took seedlings of *E. tomentosa* var. *tomentosa* and brought back to France to be germinated in a glass house. After a year, the seedlings survived but also showed very slow growth and no flower has been observed.

On the other hand, fruits of *Erycibe* species were reported as a food source for birds in Peninsular Malaysia (Ridley, 1930), and also of sun bear in Central Kalimantan, Indonesia (McConkey & Galetti, 1999). They swallow the fruits and seeds, and the seeds are then evacuated in a fit condition to germinate. Hence, birds and sunbears play as main role as dispersal agent of *Erycibe* seeds and it is also important to have *Erycibe* in a forest as their foods source. This shows that it is important not only to ensure abundance of the species but more for its ecological functions.

In addition, a few species e.g. *E. aenea*, *E. malaccensis*, *E. rheedii* and *E. tomentosa* var. *tomentosa* were reported traditionally used by local people in Peninsular Malaysia especially in medicinal aspect (Burkill, 1996).

In conservation efforts, to protect our biodiversity, or at least minimize the loss of natural resources, especially species extinction, a proper management strategy is essential. The most important aspect to consider is maintaining continuity the diversity of flora and fauna before any land development is proposed. Any activities proposed must ensure that there will no loss and degradation of the natural habitats. A few cases, some states governments have been halted for clearing for agriculture and large scale settlements, so it is vital to make sure all remaining forest areas are protected. In this way, this valuable natural habitat can be managed on a sustainable basis.

The establishment of protected and conservation areas has greater potential to prevent the loss of threatened species and also to conserve habitats not only for flora but also fauna. This suggests establishing more protected areas such as Permanent Forest Reserves, especially where the threatened species occurs. Both the Federal and State Governments need to monitor and maintain the protected areas. Besides, for future study of the genus, studies on the natural habitat, species behaviour, soil structure where the species occurs and many more ecological aspects needs to be considered to ensure an *ex situ* programme is successful.

In conclusion, although *Erycibe* species have less economic importance and uses, however they contribute to species diversity in the Malesian forest. More than 50% of the 70 taxa reported to occur in the Malesian region are endemic to political regions (Hoogland, 1953b). Of these, four taxa are endemic to Peninsular Malaysia and have threatened category. One of the worrisome factor is the species extinction probably will happen especially to the species that has not been collected more than 100 years e.g. *E. strigosa* and *E. magnifica* (both are narrowly endemic to Peninsular Malaysia). Therefore, the most appropriate solution is to do research on the habitat and population where the

taxon occurs and the sites would be better collected, which is vital in determining the status of the species.

The conservation status given to *Erycibe* species in Peninsular Malaysia is mainly based on the information from the herbarium specimens and literature unless stated to be from the field study. In future, when more information is available, re-evaluation is necessary and the conservation status of some taxa may be upgraded or downgraded.

Table 5.1. Summary of the conservation status of *Erycibe* species in Peninsular Malaysia and rationale.

No.	Species	No. of localities	IUCN Category							Summary of rationale
			CR	EN	VU	NT	LC	DD	NE	
1	*Erycibe aenea* Prain	11					√			The species is found on forest margins and in secondary forests.
2	*Erycibe albida* Prain	30					√			The species occurs in both primary and secondary forests and is widespread.
3	*Erycibe citriniflora* Griff.	7					√			The species occurs in both primary and secondary forests.
4	*Erycibe expansa* Wall. ex G. Don	3				√				Only three localities have been recorded. The last collection was made in 1933.
5	*Erycibe festiva* Prain	2		√						Criteria: B1ab(iii) The species is known from only two collections with the last collection made in 1976.
6	*Erycibe griffithii* C.B. Clarke	14					√			The species occurs in secondary forests.
7	*Erycibe leucoxyloides* King ex Prain	4			√					Criteria: A2c The latest collection was recorded in 1930. The habitat status for Batu Caves requires checking.

Note: CR = Critically Endangered, EN = Endangered; VU = Vulnerable; NT = Near Threatened; LC = Least Concern; DD= Data Deficient and NE = Not Evaluated; *endemic to Peninsular Malaysia.

Table 5.1. (continued).

No.	Species	No. of localities	IUCN Category							Summary of rationale
			CR	EN	VU	NT	LC	DD	NE	
8	*Erycibe magnifica* Prain*	2						√		Only two collections have been recorded; no collection has been made since 1883.
9	*Erycibe maingayi* C.B.Clarke	5					√			The species occurs along roads and forest margins.
10	*Erycibe malaccensis* C.B.Clarke	12					√			The species is fairly widespread.
11	*Erycibe praecipua* Prain ssp. *praecipua**	3			√					Criteria: VU A2c It is known from three localities with no collections made since 1934.
12	*Erycibe rheedii* Blume	14					√			The species is widespread.
13	*Erycibe sapotacea* Hallier *f.* & Prain ex Prain*	1		√						Criteria: A4c The species was collected from the roadside on Penang Hill in 2009.
14	*Erycibe stapfiana* Prain	9					√			The species is fairly widespread.
15	*Erycibe strigosa* Prain*	1						√		The species is only known from one locality, last collected in February 1886. Little information about the location and population.

Note: CR = Critically Endangered, EN = Endangered; VU = Vulnerable; NT = Near Threatened; LC = Least Concern; DD= Data Deficient and NE = Not Evaluated; *endemic to Peninsular Malaysia.

Table 5.1. (continued).

No.	Species	No. of localities	IUCN Category							Summary of rationale
			CR	EN	VU	NT	LC	DD	NE	
16	*Erycibe tomentosa* Blume var. *hirsuta* (Hallier *f*.) Hoogl.	1	√							Criteria: B2ab(iii) The variety is known from only one locality and has not been collected from the wild since 1952.
17	*Erycibe tomentosa* Blume var. *tomentosa*	10					√			The variety is widespread.
18	*Erycibe* sp. A	1							√	The species is not yet published as none of the specimens produce fruit and material is not enough to propose the conservation status. Therefore, the species is not evaluated until more information is discovered.
19	*Erycibe* sp. B	6							√	The species is not yet published as none of the specimens produce matured flowers. In addition, materials are not enough to propose the conservation status. Hence, the species is not evaluated until more information is discovered.

Note: CR = Critically Endangered, EN = Endangered; VU = Vulnerable; NT = Near Threatened; LC = Least Concern; DD= Data Deficient and NE = Not Evaluated; *endemic to Peninsular Malaysia.

CHAPTER 6

GENERAL DISCUSSION AND CONCLUSIONS

The present study on taxonomy and morphology has shown that *Erycibe* is represented by 19 taxa in Peninsular Malaysia, with the acception of two new taxa recognized by Ng (1989). However, the two taxa were maintained as *Erycibe* sp. A and *E.* sp. B. When more materials are found, complete with the reproductive parts (the characters of the flowers are vital and gave greater taxonomic importance), these two taxa will be described in detail.

6.1 Species delimitation of *Erycibe*

The delimitation of *Erycibe* species in Peninsular Malaysia was based on morphological characters, both the vegetative and reproductive. Vegetative characters that have taxonomic value are leaves characters including the shape, size, texture, colour of dry leaves, type of indumentum, base, margin, apex, midrib, secondary and tertiary veins, petioles length and thickness and petioles bases. Reproductive characters that are taxonomically significant include inflorescence type, length, pedicel length, indumentum of the pedicel, indumentum of the calyx, indumentum of the midpetaline bands, lobules shape, anther base and anther apex, indumentum of the ovary and stigma apex. Characters such as twig surface (which is usually changed due to the size or age of the tree), inner bark texture and colour, lobule margin and lobule venation, ovary length and width and stigma shape are not considered good taxonomic characters. Fruit characters are also useful in identifying *Erycibe* species including pedicel length, pedicel thickness, fruit shape and size, indumentum of the fruit and the shapes of cotyledon.

In addition to these morphological characters, trichome structure from calyx and midpetaline bands surface were studied using Scanning Electron Microscopy (SEM) technique. Although trichome characters has been used to distinguish *Erycibe* species (Hoogland, 1953a), they have not been examined by SEM to show the structure in detail. In identifying *Erycibe* species, the indumentum of calyx and midpetaline bands can be used as supplementary characters only. The trichome characters (hairs type and length) on both calyx and midpetaline bands surfaces are not independent and need other supporting morphological characters to distinguish the species. Moreover, the hairs length on calyx is between 130 to 1500 μm long, while the hair length on midpetaline bands is between 122 to 2000 μm long. Thus, this micro character is not suitable to be used to distinguish *Erycibe* species especially in the forest, as the hair need to be observed under a light microscope. However, Peninsular Malaysian *Erycibe* species can be identified using hair characters in combination with other vegetative and/or reproductive characters.

Erycibe sp. A is different from other species based on flower morphology and lamina character. The glomerules inflorescences are terminal and axillary and the densely stellate-hirsute indumentums on abaxial leaf surface make this specimen different fom all other species. These characters are similar to Borneo specimens (unidentified specimens) as discussed in the section 4.3.2.18.

While in *E.* sp. B., the twigs are densely stellate-hirsute with very conspicuous ridges, the inflorescences are axillary racemes and lamina are densely stellate-hirsute on abaxial surface on all parts that make the specimens different from other species occurring in Peninsular Malaysia.

From the combination of both vegetative and/or reproductive characters, a user-friendly key to the Peninsular Malaysia species/taxa was developed.

6.2 Conservation status assessment of *Erycibe* taxa

The genus *Erycibe* is not restricted to specific habitat but usually found at forest margins and gaps, near the roadsides, any gaps where sunlight is available and also in dense forest that climbing to top of canopy trees. Species/taxa revised in this study have a variety of habits ranging from shrubs, scandent shrubs, creepers or scramblers or small tree to woody climbers. There are nineteen taxa represented in Peninsular Malaysia; four are endemic namely *E. magnifica*, *E. praecipua* ssp. *praecipua*, *E. sapotacea* and *E. strigosa.* *Erycibe magnifca* and *E. strigosa* are found only in Perak. *Erycibe praecipua* ssp. *praecipua* is confined to three localities in Johor, Penang and Perak while *E. sapotacea* is restricted to Penang.

According to Chua (2011), the conservation assessment is confined to Peninsular Malaysian populations and thus, the conservation status for the indigenous flora of Peninsular Malaysia is not necessarily applicable to the species in its entire phytogeographical range. Seventeen taxa have been assessed for their conservation status. Nine taxa are categorized as LC, one taxa as NT, two taxa as VU, two taxa as EN, one taxa as CR and two taxa as DD. The two undescribed taxa (*E.* sp. A and *E.* sp. B), are not evaluated (NT). Of the five threatened taxa (has NT, VU, EN and CR category), two are endemic to Peninsular Malaysia; *E. praecipua* ssp. *praecipua* and *E. sapotacea*. *Erycibe praecipua* ssp. *praecipua* is considered as VU, has not been collected from Penang Hill since 1890 and need to be relocated. *Erycibe sapotacea* is a species with narrow geographical range, endemic to Penang Hill and occurs in the non-protected area, is considered as EN.

The main threat to all threatened *Erycibe* species/taxa in Peninsular Malaysia is land use changes caused by town or human settlement development or land use for plantations.

A few *Erycibe* species grow in unprotected areas such as roadsides or on private land. Therefore, once these areas are proposed to be developed e.g. for building private bungalows or new roads, the areas will be cleared without preserving the climbers, which are always considered to have less economic importance and uses.

Although *Erycibe* species have less economic importance and uses, they contributed to species diversity in the Malesian forest with four species endemic to Peninsular Malaysia. This study suggests establishing more protected areas such as Permanent Forest Reserves, especially where the threatened species occurs. For every regulations made, the enforcement should include the border areas since a few *Erycibe* species were collected at the forest margins or edges. In the case that species occurs in the non-protected areas e.g. Penang Hill, seedlings should be taken and replanted at an *ex situ* sites. In addition, long term research on the habitat and population where the taxon occurs should be done, which is vital in determining the status of the species/taxa. It is expected that the category of some species/taxa may be upgraded or downgraded once more information is available to re-evaluate the conservation status.

6.3 Conclusions

In this study, more than 170 herbarium specimens were examined. An investigation on morphological characters was carried out. Detailed studies on calyx and midpetaline bands were conducted using SEM technique. A user-friendly key was developed, which does not relies entirely on the reproductive characters (floral characters) as provided by Hoogland (1953a).

Conservation status assessment of the *Erycibe* species/taxa in Peninsular Malaysia shows that nine taxa are categorized as LC, one taxa as NT, two taxa as VU, two taxa as

EN, one taxa as CR and two taxa as DD. The two undescribed taxa (*E.* sp. A and *E.* sp. B), are not evaluated (NT).

In a nutshell, all the objectives of this study have been achieved. Nineteen species/taxa are clearly defined species/taxa in Peninsular Malaysia based on morphological characters. Detailed species descriptions, nomenclature, distribution maps, and user-friendly key to species/taxa are provided.

6.4 Suggestion for future work

Details studies on the palynology of *Erycibe* species/taxa may provide more useful characters. Besides, habitat status and population, ecology, plant behaviour, pollination and seed predation studies are also lacking and are needed for *Erycibe* species to give an idea at least on the population and distribution patterns which are very important aspects in conservation assessment.

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APPENDIX A: Taxon Data Information Sheet (TDIS)

MALAYSIA
PLANT RED LIST
Taxon Data Information Sheet
(Please complete one sheet per taxon)

Part I. Taxon attributes

1. Scientific name (include authority details)

2. Family

3. Synonyms

4. Common/Vernacular names (specify language)

5. Habitat Preferences

5.1 The climatic climax formation (Please select the likely formation(s) where the taxon is found. You may tick more than one)

- 5.1.1 Lowland dipterocarp forest (Malayan, Burmese) ☐
- 5.1.2 Lowland mixed dipterocarp forest ☐
- 5.1.3 Lowland evergreen forest ☐
- 5.1.4 Hill dipterocarp forest (inland, coastal) ☐
- 5.1.5 Hill mixed dipterocarp forest ☐
- 5.1.6 Upper hill dipterocarp forest (approximately 762–1219 m (2500–4000 ft) above sea level in inland ranges; 609–914 m (2000–3000 ft) in isolated mountains and coastal ranges) ☐
- 5.1.7 Montane oak forest ☐
- 5.1.8 Montane ericaceous forest ☐
- 5.1.9 Subalpine forest ☐
- 5.1.10 Seasonally dry tropical rain forest or semi-evergreen forest ☐

5.2 The edaphic climax formation (Please select the likely formation(s) where the taxon is found. You may tick more than one)

- 5.2.1 Mangrove forest ☐
- 5.2.2 Brackish water vegetation ☐
- 5.2.3 Peat swamp forest ☐
- 5.2.4 Freshwater swamp forest ☐
- 5.2.5 Other swamp vegetation (e.g., inland forest on flat land subjected to periodic inundation, excluding peat swamp, freshwater swamp) ☐
- 5.2.6 Coastal vegetation ☐
- 5.2.7 Riparian vegetation ☐
- 5.2.8 Permanent freshwater lake ☐
- 5.2.9 Limestone vegetation ☐
- 5.2.10 Quartz vegetation ☐
- 5.2.11 Heath forest/vegetation ☐
- 5.2.12 Ultramafic/ultrabasic vegetation ☐
- 5.2.13 Others (please specify)

5.3. Man-influenced/Artificial (terrestrial) (Please tick the most appropriate)

- 5.3.1 Agricultural land ☐
- 5.3.2 Plantations (e.g., rubber, oil palm, cocoa etc.) ☐
- 5.3.3 Urban areas/Wayside vegetation ☐

5.3.4 Regenerated logged-over forest ☐
5.3.5 Secondary forest comprising mainly early pioneer species ☐
5.3.6 Grassland ☐
5.3.7 Bamboo thickets ☐
5.3.8 Ex-mining land (e.g., tin) ☐
5.3.9 Others (please specify)

5.4. Man-influenced /Artificial (aquatic) (Please tick the most appropriate)
5.4.1 Ponds, reservoirs and other man-made water bodies ☐
5.4.2 Irrigated land (including irrigation channels) ☐
5.4.3 Canals and other drainage channels, ditches ☐
5.4.4 Others (please specify)

6. General information (If you have information on the aspects of occupied niches, soil type, geology, moisture regime etc. or other comments, please place details here)

7. If you have information on other aspects of the taxon's biology (taxonomy, ecology, reproductive biology etc), please place details here.

Part II. Geographical Range & Demographic Details of Population(s)

8. Is the taxon endemic to Malaysia? If yes,
8.1 Endemic to Sabah ☐
8.2 Endemic to Sarawak ☐
8.3 Endemic to Sabah & Sarawak ☐
8.4 Endemic to Peninsular Malaysia (political boundary) ☐

9. Is the taxon endemic to a phytogeographical region? If yes,
9.1 Malaya (Peninsular Malaysia, Singapore and Peninsular Thailand) ☐
9.2 Borneo (Sabah, Sarawak, Brunei and Kalimantan) ☐

10. General distribution pattern of the taxon in Malaysia (A distribution map showing the Extent of Occurrence based on historic and current locations **MUST** be attached. Please fill details of the point localities in the box below)
10.1 Found in less than 5 localities ☐
10.2 Confined to one district in Peninsular Malaysia ☐
10.3 Confined to one state in Peninsular Malaysia or within a division in Sarawak or within a district in Sabah ☐
10.4 Confined to two states in Peninsular Malaysia or two divisions in Sarawak or two districts in Sabah ☐
10.5 Widespread ☐

11. Extent of occurrence in and around the area of study/sightings/collection (actual, approximation or inferred)
11.1 Less than 100 km^2 ☐
11.2 Between 100 and 5,000 km^2 ☐
11.3 Between 5,001 and 20,000 km^2 ☐
11.4 Greater than 20,001 km^2 ☐
11.5 Unknown ☐

Part III. Red List Category & Criteria Assessment

Part III(a). Population Decline

12. Status of habitat where the taxon occurs (i.e., changes to the taxon's natural distribution range/localities)
    - 12.1 Has the habitat decreased
      - 12.1.1 Yes ☐
      - 12.1.2 No ☐
    - 12.2 If decreasing, what has been the approximate percentage decrease in habitat over the last 10 years or three generations, whichever is the longer.
      - 12.2.1 Less than 30% ☐
      - 12.2.2 Less than 50% ☐
      - 12.2.3 Less than 80% ☐
      - 12.2.4 More than 80% ☐
      - 12.2.5 Decreased to an unknown percentage ☐
    - 12.3 If stable or unknown in the past, do you predict an approximate percentage decline in habitat over the next 10 years or three generations, whichever is the longer?
      - 12.3.1 Less than 30% ☐
      - 12.3.2 Less than 50% ☐
      - 12.3.3 Less than 80% ☐
      - 12.3.4 More than 80% ☐
      - 12.3.5 Unknown ☐
    - 12.4 Is there a change in the condition/quality of the habitat where the taxon occurs?
      - 12.4.1 Stable ☐
      - 12.4.2 Noticeable degradation ☐
      - 12.4.3 Unknown ☐
13. Approximate number of mature individuals
    - 13.1 Less than 50 ☐
    - 13.2 Between 51 and 250 ☐
    - 13.3 Between 251 and 1000 ☐
    - 13.4 Between 1001 and 2500 ☐
    - 13.5 Greater than 2500 ☐
    - 13.6 Unknown ☐
14. Status of population of the taxon
    - 14.1 Has the population declined in number?
      - 14.1.1 Yes ☐
      - 14.1.2 No ☐
    - 14.2 If declining, what is the percentage of population decline inferred or suspected over the last 10 years or three generations, whichever is the longer?
      - 14.2.1 Less than 30% ☐
      - 14.2.2 Less than 50% ☐
      - 14.2.3 Less than 80% ☐
      - 14.2.4 More than 80% ☐
      - 14.2.5 Declined to an unknown percentage ☐
    - 14.3 If stable or unknown in the past, do you predict a future decline in the population over the next 10 years or three generation, whichever is the longer?
      - 14.3.1 Less than 30% ☐
      - 14.3.2 Less than 50% ☐
      - 14.3.3 Less than 80% ☐

14.3.4 More than 80% ☐
14.3.5 Unknown ☐

15. Data quality. Are all the above estimates based on (Please tick three most appropriate)
    - 15.1 Inventory ☐
    - 15.2 Literature ☐
    - 15.3 Herbarium records ☐
    - 15.4 Census/Monitoring ☐
    - 15.5 Anecdotal information ☐
    - 15.6 Indirect information (e.g., from trade, forest cover etc) ☐
    - 15.7 Other information (please specify)

16. Have any population studies/inventory been done on this taxon? (Please list the most relevant. If the study is approved, and fully or partially funded by the Malaysian Government, or approved under bilateral or multilateral agreements, specify in the following order: project title; starting and ending year of project; agencies; names of collaborators)

17. Does this species require detailed population-based ecological studies? If yes, please explain briefly.

Part III(b). Threats

18. Threats to the habitat (human induced) (Please select three most important)
    - 18.1 Agro-forestry
        - 18.1.1 Forest plantations
            - 18.1.1.1 Small-scale, less than 50 ha ☐
            - 18.1.1.2 Large-scale, more than 50 ha ☐
        - 18.1.2 Agriculture
            - 18.1.2.1 Shifting ☐
            - 18.1.2.2 Small-holders ☐
            - 18.1.2.3 Agro-industry/large-scale plantations ☐
        - 18.1.3 Aquaculture ☐
        - 18.1.4 Unknown ☐
        - 18.1.5 Others (please specify)

    - 18.2 Extraction
        - 18.2.1 Mining ☐
        - 18.2.2 Forestry
            - 18.2.2.1 Subsistence ☐
            - 18.2.2.2 Selective logging ☐
        - 18.2.3 Non-timber forest products ☐
        - 18.2.4 Unknown ☐
        - 18.2.5 Others (please specify)

    - 18.3 Infrastructure development
        - 18.3.1 Industry ☐
        - 18.3.2 Human settlement ☐
        - 18.3.3 Tourism/recreation ☐
        - 18.3.4 Transport – land/air ☐
        - 18.3.5 Transport – water ☐
        - 18.3.6 Dams ☐
        - 18.3.7 Telecommunication/power lines ☐
        - 18.3.8 Unknown ☐
        - 18.3.9 Others (please specify)

18.4 Land management in non-agricultural areas
- 18.4.1 Abandonment ☐
- 18.4.2 Change in management regime ☐
- 18.4.3 Unknown ☐
- 18.4.4 Others (please specify)

18.5 Unknown ☐

18.6 Others (please specify)

19. Taxon harvested for (Please list the three most appropriate)

19.1 Food
- 19.1.1 Subsistence use/local trade ☐
- 19.1.2 Sub-national/national trade ☐
- 19.1.3 Regional/international trade ☐

19.2 Medicine
- 19.2.1 Subsistence use/local trade ☐
- 19.2.2 Sub-national/national trade ☐
- 19.2.3 Regional/international trade ☐

19.3 Timber and non-timber forest products
- 19.3.1 Subsistence use/local trade ☐
- 19.3.2 Sub-national/national trade ☐
- 19.3.3 Regional/international trade ☐

19.4 Cultural/scientific/leisure activities ☐

19.5 Fuel ☐

19.6 Unknown ☐

19.7 Others (please specify)

20. Natural disasters

20.1 Floods ☐

20.2 Fire ☐

20.3 Drought ☐

20.4 Landslides ☐

20.5 Unknown ☐

20.6 Others (please specify)

21. Changes in native species dynamics

21.1 Competitors ☐

21.2 Pathogens ☐

21.3 Hybridisation ☐

21.4 Host plants ☐

21.5 Unknown ☐

21.6 Others (please specify)

22. Intrinsic factors

22.1 Restricted range ☐

22.2 Low densities ☐

22.3 Limited dispersal ☐

22.4 Poor recruitment, reproduction, regeneration ☐

22.5 High juvenile mortality ☐

22.6 Inbreeding ☐

22.7 Skewed sex ratio ☐

22.8 Slow growth rates ☐

22.9 Population fluctuations ☐

22.10 Low densities of pollinators ☐

22.11 Unknown ☐
22.12 Others (please specify)

23. Pollution (affecting habitat and/or species) (Please select the most appropriate)
    23.1 Atmospheric Pollution
        23.1.1 Acid precipitation ☐
        23.1.2 Haze ☐
        23.1.3 Unknown ☐
        23.1.4 Others (please specify)

    23.2 Land pollution
        23.2.1 Agriculture ☐
        23.2.2 Domestic ☐
        23.2.3 Commercial/industrial ☐
        23.2.4 Other non-agriculture ☐
        23.2.5 Unknown ☐
        23.2.6 Others (please specify)

    23.3 Water pollution
        23.3.1 Agriculture ☐
        23.3.2 Domestic ☐
        23.3.3 Commercial/industrial ☐
        23.3.4 Oil slicks ☐
        23.3.5 Sediment ☐
        23.3.6 Sewage ☐
        23.3.7 Solid waste ☐
        23.3.8 Unknown ☐
        23.3.9 Other (please specify)

    23.4 Unknown ☐
    23.5 Others (please specify)

24. Other human disturbances
    24.1 Research ☐
    24.2 War/civil unrest ☐
    24.3 Unknown ☐
    24.4 Others (please specify)

25. Invasive alien species (directly affecting the species)
    25.1 Competitors ☐
    25.2 Pathogens ☐
    25.3 Hybridization ☐
    25.4 Unknown ☐
    25.5 Others (please specify)

26. Persecution
    26.1 Pest control ☐
    26.2 Unknown ☐
    26.3 Others (please specify)

27. Unknown ☐

28. Others (please specify)

29. Red List Category (use the IUCN Version 3.1 (2001) and tick only one. If either CR, EN or VU is selected, then all criteria, sub-criteria and sub-subcriteria met for that category must be listed in the space provided (e.g., A2c+3c;B1ab (ii); D)

- ☐ Extinct (EX)
- ☐ Extinct in the Wild (EW)
- ☐ Critically Endangered (CR) Criteria
- ☐ Endangered (EN) Criteria
- ☐ Vulnerable (VU) Criteria
- ☐ Near Threatened (NT)
- ☐ Least Concern (LC)
- ☐ Data Deficient (DD)
- ☐ Not Evaluated (NE)

30. Rationale for the Red List Assessment (including whatever population or range information used, inferences, assumptions etc. In cases, where more than one threat category may apply, describe why you have chosen the category marked above and what conditions or information would change the assessment. For NT, specify what criteria were nearly met and for DD specify what little information is known. Use additional sheets if necessary)

Part IV. Current Conservation Measures for the Taxon

31. Are there any conservation measures in place?
    - 31.1 Yes ☐
    - 31.2 No ☐

32. Are conservation measures needed?
    - 32.1 Yes ☐
    - 32.2 No ☐

33. Policy-based measures (please select the most appropriate and elaborate in the box below if measures are in place)

	In place	Needed
33.1 Management plan	☐	☐
33.2 Legislation	☐	☐
33.3 Community management	☐	☐
33.4 Others (please specify)		

Please provide details of the measures/legislation that are already in place.

34. Communication and Education

	In place	Needed
34.1 Formal education	☐	☐
34.2 Awareness	☐	☐
34.3 Capacity building/training	☐	☐
34.4 Others (please specify)		

35. Research (Please list three most important)

	In place	Needed
35.1 Taxonomy	☐	☐

35.2 Population range, size and viability ☐ ☐
35.3 Biology, ecology and genetics ☐ ☐
35.4 Habitat status ☐ ☐
35.5 Threats ☐ ☐
35.6 Uses and harvest levels ☐ ☐
35.7 Cultural relevance ☐ ☐
35.8 *In situ* and *ex situ* conservation measures ☐ ☐
35.9 Long term monitoring ☐ ☐
35.10 Others (please specify)

36. *In situ*/habitat conservation (Please list three most important)

	In place	Needed
36.1 Protected areas		
36.1.1 Integrity of established protected areas	☐	☐
36.1.2 Identification of new sites for protected areas	☐	☐
36.1.3 Management Plan	☐	☐
36.2 Community-based initiatives	☐	☐
36.3 Rehabilitation	☐	☐
36.4 Restoration	☐	☐
36.5 Corridors	☐	☐
36.6 Others (please specify)		

37. Species-based conservation

	In place	Needed
37.1 Sustainable use		
37.1.1 Harvesting Plan	☐	☐
37.1.2 Trade Management	☐	☐
37.1.3 Timber Certification	☐	☐
37.2 *Ex situ* conservation		
37.2.1 Field germplasm, seed genebanks etc.	☐	☐
37.2.2 Artificial propagation	☐	☐
37.3 Re-introduction	☐	☐
37.4 Recovery management	☐	☐
37.5 Disease, pathogen, pest management	☐	☐
37.6 Others (please specify)		

38. Enforcement

	In place	Needed
38.1 Government enforcement	☐	☐
38.2 Community-based enforcement	☐	☐

Part IV. Utilisation

39. Taxon is used locally, nationally or globally (if no, do not fill up the remaining questions in this part)
39.1 Yes ☐
39.2 No ☐

40. Purpose/type of use (Please list the three most appropriate and alongside the code, select the appropriate level of use, i.e., S=Subsistence; N=National, I=International)

	S	N	I

40.1	Food for human	☐	☐	☐
40.2	Food for animals	☐	☐	☐
40.3	Medicine for human and veterinary	☐	☐	☐
40.4	Poisons	☐	☐	☐
40.5	Manufacturing chemicals	☐	☐	☐
40.6	Other chemicals	☐	☐	☐
40.7	Fuel	☐	☐	☐
40.8	Fibre	☐	☐	☐
40.9	Construction/structural materials, furniture	☐	☐	☐
40.10	Wearing apparel, accessories	☐	☐	☐
40.11	Other household goods	☐	☐	☐
40.12	Handicrafts, decorations, curios etc.	☐	☐	☐
40.13	Horticulture	☐	☐	☐
40.14	Research	☐	☐	☐
40.15	Specimen collecting	☐	☐	☐
40.16	Unknown	☐	☐	☐
40.17	Others (Please specify)			

41. Primary forms removed from the wild (Please estimate the percentage of the total harvest/off take contributed)

		0-50%	50-100%
41.1	Whole plant	☐	☐
41.2	Parts–non-fatal removal	☐	☐
41.3	Parts–fatal parts removal	☐	☐
41.4	Unknown	☐	☐
41.5	Others (please specify)		

42. Source of specimen in commercial trade (The percentage of the harvest/offtake for commercial trade (i.e., not for subsistence use) that is taken from a particular production system)

		0-50%	50-100%
42.1	Wild	☐	☐
42.2	Artificial propagation	☐	☐
42.3	Unknown	☐	☐
42.4	Others (please specify)		

43. CITES status

43.1	Taxon not listed in the CITES Appendices	☐
43.2	Taxon listed in Appendix I	☐
43.3	Taxon listed in Appendix II	☐
43.4	Taxon listed in Appendix III	☐

44. If you have other comments, please place details here.

45. Literature used in the assessment (please follow the following format for citations that do not appear in the drop-down box: Adema, F., Leenhouts, P.W. & Welzen, P.C. van. 1994. Sapindaceae. *Flora Malesiana, Ser. I*, 11: 419–768; Anonymous, 1992. *Third National Forest Inventory*. Forestry Department Peninsular Malaysia, Kuala Lumpur. 121 pp.; Ng, F.S.P. 1991. *Manual of Forest Fruits, Seeds and Seedlings*. Volume One. Malayan Forest Records No. 34. Forest Research Institute Malaysia, Kepong. 400 pp.; Raemaekers, J.J., Aldrich-Blake, F.P.G. & Payne, J.B. 1980. The forest. Pp. 29–61 in Chivers, D.J. (ed.). *Malayan Forest Primates. Ten Years' Study in Tropical Rain Forest*. Plenum Press, New York.)

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Ridley, H.N. 1922–1925. *The Flora of the Malay Peninsula*. Volumes 1–5. Reeves & Co., London. ☐
Seidenfaden, G. & Wood, J.J. 1992. *The Orchids of Peninsular Malaysia and Singapore*. Olsen & Olsen, Fredensborg. 779 pp. ☐
Soepadmo, E. & Wong, K.M. (eds.) 1995. *Tree Flora of Sabah & Sarawak*. Volume 1. Forest Research Institute Malaysia, Kuala Lumpur, Sabah Forestry Department, Sandakan & Sarawak Forestry Department, Kuching. 513 pp. ☐
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Symington, C.F. 2004 (Revised by Ashton, P.S. & Appanah, S.). *Foresters' Manual of Dipterocarps*. Malayan Forest Records No. 16. Forest Research Institute Malaysia & Malaysian Nature Society. 519 pp. ☐
Turner, I.M. 1995. A Catalogue of the Vascular Plants of Malaya. *The Gardens' Bulletin Singapore* 47: 1–757. ☐
Whitmore, T.C. (ed.) 1972b. *Tree Flora of Malaya*. Volume 1. Malayan Forest Records No. 26. Longman Malaysia Sdn. Bhd., Kuala Lumpur. 471 pp. ☐
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Whitmore, T.C. 1973b. *Palms of Malaya*. Oxford University Press, Singapore. 132 pp. ☐

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46. Details of Assessor

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47. Other contributors to be credited for this taxon

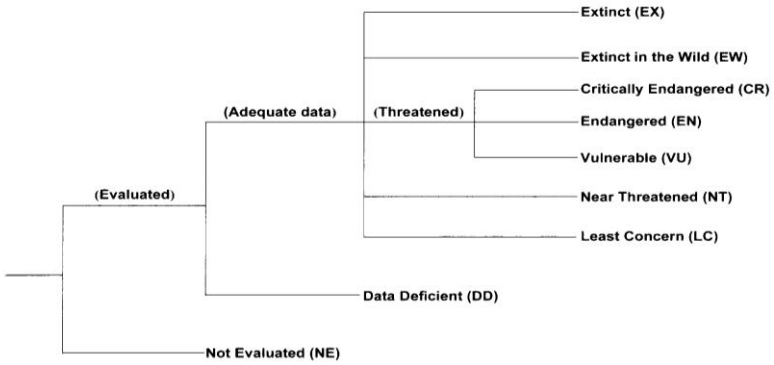
Full Name & Title :
Job Designation :
Mailing address :
Telephone :
Fax :
E-mail :

Full Name and Title:
Job Designation :
Mailing address :
Telephone :
Fax :
E-mail :

48. Date of Assessment: day: month: year:

49. Name(s) of Evaluator(s) — to be filled in by the Secretariat of the Threat Assessment Project ONLY

APPENDIX B: Summary of the five criteria used to evaluate if a taxon belongs in a threatened category



Appendix 2. Summary of the five criteria (A–E) used to evaluate if a taxon belongs in a threatened category (Critically Endangered, Endangered or Vulnerable) (available from the IUCN website (http://www.iucn.org).

Criterion	Critically Endangered	Endangered	Vulnerable
A. Population reduction	Declines measured over the longer of 10 years or 3 generations		
A1	>90%	>70%	>50%
A2, A3 & A4	>80%	>50%	>30%
A1. Population reduction observed, estimated, inferred or suspected in the past where the causes of the reduction are clearly reversible and understood and ceased based on and specifying any of the following: a) direct observation b) an index of abundance appropriate for the taxon c) a decline in area of occupancy, extent of occurrence and/or habitat quality d) actual or potential levels of exploitation e) effects of introduced taxa, hybridisation, pathogens, pollutants, competitors or parasites.			
A2. Population reduction observed, estimated, inferred or suspected in the past where the causes of reduction may not have ceased or may not be understood or may not be reversible based on any of (a) to (e) under A1.			
A3. Population reduction projected or suspected to be met in the future (up to a maximum of 100 years) based on any of (b) to (e) under A1.			
A4. An observed, estimated, inferred, projected or suspected population reduction (up to a maximum of 100 years) where the time period must include both the past and the future and where the causes of reduction may not have ceased or may not be understood or may not be reversible based on any of (a) to (e) under A1.			
B. Geographic range in the form of either B1 (extent of occurrence) or B2 (area of occupancy)			
B1. Either extent of occurrence	<100 km^2	<5,000 km^2	<20,000 km^2
B2. Or area of occupancy	<10 km^2	<500 km^2	<2,000 km^2
and 2 of the following 3:			
a) severely fragmented or # location	=1	=2–5	=6–10
b) continuing decline in (i) extent of occurrence (ii) area of occupancy (iii) area, extent and/or quality of habitat (iv) number of locations or subpopulations (v) number of mature individuals			
c) extreme fluctuations in any of (i) extent of occurrence (ii) area of occupancy (iii) number of locations or subpopulations and (iv) number of mature individuals			
C. Small population size and decline			
Number of mature individuals and either **C1** or **C2**	<250	<2,500	<10,000
C1. An estimated continuing decline of at least up to a maximum of 100 years	25% in 3 years or 1 generation	20% in 5 years or 2 generations	10% in 10 years or 3 generations
C2. A continuing decline and (a) and/or (b)			
(a i) # mature individuals in largest subpopulation	<50	<250	<1,000
(a ii) or % individuals in one subpopulation =	90–100%	95–100%	100%
(b) extreme fluctuations in the number of mature individuals			
D. Very small or restricted population			
Either (1) number of mature individuals	<50	<250	<1,000
or (2) restricted area of occupancy	na	na	typically AOO<20 km^2 or # locations ≤5
E. Quantitative analysis			
Indicating the probability of extinction in the wild to be at least	50% in 10 years or 3 generations (100 years maximum)	20% in 20 years or 5 generations (100 years maximum)	10% in 100 years