

**REVISION OF THE GENUS PHYLLAGATHIS  
(MELASTOMATACEAE: SONERILEAE)  
I. THE SPECIES IN BURMA, THAILAND,  
PENINSULAR MALAYSIA AND SUMATRA**

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SUMMARY

A revision of the genus *Phyllagathis* Blume is presented under a wider generic concept than used by earlier authors. A comprehensive synopsis of the genus is provided in the general part, where morphological characters and their variations are discussed. This paper will focus in particular on the species occurring in Burma, Thailand, Peninsular Malaysia (West Malaysia), and Sumatra. Here, the genus includes 10 species, most of which are endemic to Peninsular Malaysia, with only two species endemic to Thailand (*P. siamensis* and *P. tuberosa*), and two other also occurring outside the Malaysian political boundaries (*P. rotundifolia* and *P. hispida*). Part II of this paper will treat the species of Borneo and Natuna Island.

**Key words:** *Phyllagathis*, Sonerileae, Burma, Peninsular Malaysia, Sumatra, Thailand, taxonomy.

INTRODUCTION

*Phyllagathis* Blume (Melastomataceae) is a genus endemic to the Old World tropics and belonging to the tribe Sonerileae. It comprises about 56 herbaceous or somewhat woody or occasionally subshrubby species. Its distribution ranges from South China, Vietnam, Laos, Thailand, and West Malaysia to Sumatra and Borneo. The genus in South China and Indochina was revised by the late Carlo Hansen (1992) who also left a collection of notes on the species of Malaysia and Indonesia. Upon careful examination of his notes and study of a large number of specimens, revision of the genus throughout its range is complete. Hansen's generic concepts within the Sonerileae result in a paraphyletic *Phyllagathis* (Cellinese, 1999 and in prep.), and his species delimitation often did not account for natural range of variation. Therefore, this work is my independent attempt in redefining the genus and several of its species. Moreover, I am planning to update Hansen's treatment of the species of South China and Indochina to include the genus *Tigridiopalma* C. Chen which appears to fall within the morphological and phylogenetic boundaries of *Phyllagathis* (Cellinese, 1997, 1999 and in prep.). The Malayan, Thai, Burmese and Sumatran taxa, as the species of Borneo and China and Indochina, do not form a monophyletic group (Cellinese, 1999 and in prep.), and

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are here treated separately on the basis of convenient regional boundaries, given all the species treated here are endemic to these areas.

#### SYSTEMATIC POSITION WITHIN THE FAMILY

The Melastomataceae are a large, pantropical family of c. 150–166 genera and about 4570 species (Renner, 1993). The family is most diverse in the Neotropics and around one third of the known species occur in the Palaeotropics.

The tribe Sonerileae was first established in 1865 by J. Triana in his 'Dispositio Melastomacearum'. The tribe included Old World, mainly herbaceous species, whereas Old World shrubby species were part of the tribe Oxysporeae. He also established the tribe Bertolonieae to include all of the New World taxa.

Hooker (1867) recognized only two major tribes: the Oxysporeae and the Sonerileae. He sunk Bertolonieae in the Sonerileae, and the tribe as such was divided into three series: Series I (Asiaticae), Series II (Africanae) and Series III (Americanae). In 1871 Triana reinstated the tribe Bertolonieae to separate the New and Old World taxa.

Cogniaux (1891), Krasser (1893) and later authors used Triana's classification with the addition of several more genera in each tribe. The main reason for the recognition of the Bertolonieae was the anisomery of flowers and their New World distribution, whereas the Oxysporeae and Sonerileae have isomerous flowers and an Old World distribution. Based mainly on their study of the wood anatomy of the Melastomataceae, Van Vliet et al. (1981) proposed a new classification where both Oxysporeae and Bertolonieae were included in the Sonerileae.

Phylogenies of the family based on *rbcL*, *ndhF*, and *rpl16* molecular evidences (Clausing & Renner, 2001) suggest that the Sonerileae s.l. are not monophyletic. The Asian and African Sonerileae form a natural group with the exclusion of the Bertolonieae.

#### TAXONOMIC HISTORY

*Phyllagathis* was established by Carl Ludwig Blume in 1831 (1831a, b). *Melastoma rotundifolium* Jack became the basionym of *Phyllagathis rotundifolia* (Jack) Blume and the generic type. The original type specimen (*Jack s.n.*, Musi Country, interior of Sumatra) was unfortunately lost in a shipwreck. Blume established the new genus as distinct from *Melastoma* in having a different habit and various vegetative and reproductive structures. The genus was later discussed by several authors including Don (1831), Meisner (1837), and Endlicher (1840). Korthals (1844) added a second species, *P. gymnantha* from Borneo, and the genus appeared in later works of Walpers (1846), Miquel (1856, 1860), Hooker (1867), Triana (1865, 1871), Baillon (1877) and Clarke (1879).

Cogniaux (1891) recognized two species of *Phyllagathis*, and also described four new species of *Allomorpha* and one species of *Anerincleistus*. These were later transferred to *Phyllagathis* by Nayar (1976), Hansen (1982) and Maxwell (1982). In 1894, Cogniaux added another species, *P. hirsuta* from Borneo, which I reduce to synonymy under *P. gymnantha* in this revision.

Otto Stapf (1892) in his paper 'On the Sonerileae of Asia' recognized *Phyllagathis* as a genus of three species, making a new combination (*P. tonkinensis*) based on

*Sonerila tonkinensis* Cogn. (1891). In 1894 Stapf also contributed to 'Hooker's Icones plantarum' describing *Phyllagathis elliptica* and *P. uniflora*, the latter reduced to synonymy of *Anerincleistus dispar* Cogn. (1891) and later transferred to *Phyllagathis* by Hansen (1982).

George King (1900) added a new taxon to *Phyllagathis* with *P. griffithii* (*Allo-morphia griffithii* Hook. f. ex Triana) and described three new species, *P. hispida*, *P. scortechinii* and *P. tuberculata*; all these species are endemic to Peninsular Malaysia with the exception of *P. hispida*, present also in Thailand and Sumatra.

Another Malayan species was described by Henry Nicholas Ridley (1912) as *Phyllagathis cordata*. In his 'Flora of the Malay Peninsula' (1922) he recognized six species. In 1946 he provided another contribution with the description of *P. peltata* Stapf ex Ridl., a new species from Borneo. More Bornean species were described by Oskar Schwartz (1931) and Bakhuizen van den Brink (1943), who also described two species from Sumatra; all these species have been placed into synonymy in this revision.

André Guillaumin was the first person to be concerned with the species of China and Indochina. In 1913 he published a new species, *P. hirsuta* (nom. ill.) later renamed *P. guillauminii* H.L. Li (1944); he also made a new combination (*P. cavaleriei*) with *Oxyspora cavaleriei* Lév. and described *Medinilla marumiaetricha*, which was transferred to *Phyllagathis* by Hansen (1992); *Medinilla* (tribe Dissochaetae) is a genus of epiphytic and terrestrial shrubs and climbers and is very distinct from *Phyllagathis*. Diels (1932) was also interested in the flora of China and he described a few *Phyllagathis* species, some of which were transferred to *Stapfiophyton* by Li (now included in *Fordiophyton*, another sonerilean genus). *Fordiophyton* is a genus close to *Sarcopyramis* in habit, but differs by its striking stamen dimorphism and capsule morphology. After 1944, a few recent Chinese authors have described a large number of taxa, bringing the total number of Chinese and Indochinese species to 41 (Hansen, 1992). A number of *Phyllagathis* species also from China and Indochina, Peninsular Malaysia and Borneo have more recently been described by Nayar (1965, 1976), Weber (1981, 1987, 1990), Kiew (1987, 1989), Stone & Weber (1987) and Hansen (1990b).

#### GEOGRAPHIC DISTRIBUTION

The genus *Phyllagathis* occurs in two disjunct areas: China–Indochina and the Sunda Shelf. High levels of endemism occur in both areas. The majority of species have restricted distributions, and only a few species are relatively widespread within an area.

Fifteen species occur in Vietnam and, of these, twelve are endemic. The remainder of the species are restricted to Yunnan, Guangxi and Guangdong, and the majority of these are also endemic to those areas. A much smaller number can be found in the provinces of Hainan, Sichuan, Fukien, Hubei, Guizhou and in Laos. No species have been recorded from Cambodia, but I believe this might be due either to under-collecting or to difficulties accessing material (especially unnamed) stored in Cambodian, Vietnamese and Chinese institutions. Twenty-nine species occur on the Sunda Shelf, and most of these are found in Peninsular Malaysia and Borneo.

There are only two species endemic to Thailand, *Phyllagathis siamensis* and *P. tuberosa*. There are no species endemic to Burma and Sumatra with most species being endemic to Peninsular Malaysia. Two more species occur outside the political

boundaries of Malaysia. *Phyllagathis rotundifolia* is also found in Sumatra, Peninsular Thailand and Burma, and *P. hispida* occurs also in Sumatra and Thailand.

#### ECOLOGY

*Phyllagathis* is a group of understory perennial herbs growing in shade and humid environments, characterized mainly by high rainfall and little in the way of prevailing winds. Species of *Phyllagathis* are often found by rivers and/or on banks by waterfalls. It is not uncommon to find species of *Phyllagathis* growing as epiphytes low down on tree trunks or as lithophytes on rocks and on mossy substrates, sometimes forming a mat as thick as 20–30 cm (Cellinese, 1999). Elevations and habitat are variable, and usually range from lowland dipterocarp forests at about 20–500 m to montane forests up to around 2000 m. Only a few species grow above that elevation, and commonly, most species are found between 100 and 1500 m.

*Phyllagathis* has hermaphroditic flowers which are bee pollinated. The fruit is a dry capsule from a perigynous ovary, and seed dispersal is mainly achieved by rain splash. A detailed illustration of the *Phyllagathis* capsule and its seed dispersal mechanism is found in Stone & Weber (1987) and Weber (1987).

Pigmentation on the leaves of several species of *Phyllagathis* is also characteristic of other Sonerileae and many other tropical understory herbs. Very often the lower leaf surface is tinged with red due to presence of anthocyanins. Anthocyanin association with the leaf undersurface pigmentation suggests a selective advantage to plants in extreme shade (Lee & Lowry, 1975; Lee, 1977; Gould & Lee, 1995). Anthocyanins should absorb at wavelengths otherwise absorbed by chlorophyll b, which has a longer wavelength absorbance in the Soret band (Lee et al., 1980; Lee, 1986; Lee et al., 1990; Gould & Lee, 1995). This diminishes photo-inhibition and increases maximum photosynthesis.

Another characteristic is the maculation, or whitish spots, often present on the upper leaf surface. Sometimes spots are considered a stable morphological character within a species because of their presence throughout the leaf's life-span. However, in other species, spots are present only during the juvenile leaf stage, then disappear in the adult, and this can also vary between different individuals in a population. More research is currently underway over the function of leaf spots and other variegations. It has also been suggested that variegated leaves might be associated with a form of protection from herbivory (Givnish, 1990).

#### TOWARDS A WIDER CONCEPT OF THE GENUS PHYLLAGATHIS

*Phyllagathis* was formerly considered to be strictly tetramerous with diplostemonous flowers. While revising the species of China and Indochina, Hansen (1992) accepted *P. tetrandra* Diels, the first haplostemonous species, as part of the genus. Additionally, he observed pentamerous flowers in species such as *P. rotundifolia*, *P. scortechinii* and *P. prostrata* (Hansen, 1992). The occurrence of pentamery in *Phyllagathis* is not merely occasional. Field observations were recorded in which a few species easily switched from tetramery to pentamery, often within the same individual (Cellinese, pers. obs.). Additionally, merosity is highly variable in many other genera of the Melastomataceae.

Delimitation based solely on this character becomes unacceptable. Several small pentamerous genera, previously accepted, must now be included in *Phyllagathis*. These are *Cyanandrium* Stapf (1895) with five species, the monotypic *Brittenia* Cogn. (1890, 1891), and the ditypic *Enaulophyton* Steenis (1932), all endemic to Borneo and Natuna Island. Based on the description of *Tigridiopalma* C. Chen (1979), a Chinese monotypic genus of South China, it seems clear that it falls within the morphological and phylogenetic boundary of *Phyllagathis* (Cellinese, 1999 and in prep.). Material belonging to this taxon was not provided upon request to Chinese institutions.

Haplostemony rarely occurs in *Phyllagathis*, but there is no justification to discriminate on this character alone. Therefore, the ditypic genus *Tylanthera* (Hansen, 1990a) was formally included in *Phyllagathis* (Cellinese & Renner, 1997) and a discussion is therein presented. Switches from diplostemonous to haplostemonous androecia occur in many other genera, even between closely related species (Renner, 1989, 1993).

## GENERAL MORPHOLOGY

### *Vegetative morphology*

The species of *Phyllagathis* are perennial herbs, usually caulescent or acaulescent to subcaulescent where the stem and internodes are present but still very short; occasionally they are shrublets or shrubs, especially in South China–Indochina, rarely in the Indo-Pacific region. These can be much-branched or little-branched, rarely reduced to a single stem (e.g., *P. tuberculata*). The caulescent species are generally erect, but often part of the stem is prostrate and rooting especially at the base. The ability to produce stolons in *P. stolonifera* in swampy environments is unique in the genus and a derived feature (Cellinese, 1999 and in prep.). Tubers are also rare and occur only in species with a stunted growth (e.g., *P. tuberosa*).

Shoot growth is sympodial and each module is derived from an axillary bud in the uppermost leaf pair. Dichasial and monochasial growth are both present. Monochasial growth, however, seems to be more common, especially in (sub)acaulescent species.

Nearly all species have some form of indumentum on vegetative and/or reproductive organs. The indumentum is extremely variable between, and often within species. This consists mainly of minute brown glands or gland-tipped hairs, uniseriate or pauciseriate hairs, bristles, and less commonly hypanthial emergences of different kinds. Excellent illustrations of hairs and emergences in the Melastomataceae are provided by Wurdack (1986).

Examination of leaf anatomy shows little character variation; however, in a few Bornean and Chinese species raphides (crystals of calcium oxalate) are present both in the vegetative and reproductive parts. Although they are rarely conspicuous, they can be observed on the leaf surface as whitish oblong spots (Hansen, 1992).

Leaves are opposite, but occasionally appear slightly alternate to alternate due to some displacement or complete leaf abortion. Some species (e.g., *P. scortechinii*) display an aberrant type of growth where inflorescences and leaves are often displaced on vegetative carriers called phyllophores (Weber, 1982). Leaves are usually equal to slightly unequal, or rarely strongly unequal (Chinese and Bornean species). The typical melastome acrodromous venation is characteristic of most *Phyllagathis* species. Occasionally, however, leaves are plinerved where the middle pair of nerves slightly or

clearly arise from the base of the leaf blade. Secondary and tertiary venations are usually very distinct in all species.

### *Reproductive morphology*

A spike-like thyrse seems to be the most primitive inflorescence type found in the genus (Hansen, 1992; Cellinese, 1999 and in prep.). It might differ regarding the presence or absence of additional long scorpioid branches at the basal node of the inflorescence. The scorpioid flower arrangement along the rachis is also a plesiomorphic condition associated mostly with thyrsoid inflorescences, but occasionally with more contracted forms of this type. Pleiochasia are found in Bornean species where this form of contracted thyrse is displayed as four radial scorpioid branches arising from a single node. The head-like inflorescence found in *P. rotundifolia* is also a much contracted thyrse with an arrangement of scorpioid flowers.

Umbels are clearly contracted forms of the basic inflorescence type. The peduncle is long and the degree of reduction varies from having rare compound umbels to simple umbels to simple dichasia to solitary flowers. Often more than one contracted form is displayed within a species, for example in *P. fruticosa* we find both dichasial and solitary flowers.

Flowers vary from being tetramerous to occasionally pentamerous. A switch from diplostemony to haplostemony also occurs in some Chinese and Thai species, therefore flowers might display one or two whorls of four stamens. Anthers in the two whorls can be dimorphic or isomorphic, equal to unequal. The connective is very distinct and usually divides into a dorsal and two ventral parts. Rarely it is enlarged into a flat ridge (e.g., *P. siamensis*). Dorsally it might display a small tubercle to a long spur. Ventrally it might have filaments, strands more or less adnate to the base of the sacs, or lobe-like appendages or tubercles. Sometimes ventral or dorsal appendages are lacking.

The anthers dehisce through an apical pore the size of which can vary between being as large as the anther tip or minute and hardly visible. Anthers with minute pores are found mainly among Indo-Pacific species.

When still in bud, the most distal portion of the anther is usually enclosed into pockets. These can be shallow if their depth does not exceed half the size of the ovary, or deep when sometimes they meet almost at the base of the ovary. Deep anther pockets are very common among Chinese species.

Calyx lobes can be free, but often they are partly connate, and occasionally totally fused. In a few species, long filiform appendages alternate to the calyx lobes.

The ovary is 4- or 5-locular and is adnate by septa to the hypanthium. The degree of adnation is either partial to half the length of the ovary or full. Apically it is usually crowned by four large quadrangular lobes, free, or partially to fully connate. The upper margin lobes are usually entire, but occasionally distinctly denticulate. Ovaries lacking crowns are rare in the genus and in the whole tribe; occasionally rudimentary crowns or ornamental hairs or bristles occur. A consequence of the lack of ovary crown is that these structures are absent also from the capsules. The structural function of ovary crowns is still not clear.

The placentae are clearly stalked and protrude into the ovary locules; rarely they are sessile (only in Chinese species). The placental column is most often split into its

four vascular bundles which resemble horns. Horns vary in length and shape, and rarely are reduced to tubercles or are completely absent.

The typical phyllagathoid fruit is a dry quadrangular or pentangular cup-shaped capsule, rarely urceolate, and usually distinctly ribbed. In a few species, however, the ribs are hardly visible or totally absent. In several Indo-Pacific species the adjoining halves of the fruit walls (carpels) are accrescent and smoother, giving rise to a less angular and therefore obconical capsule. Usually, the persistent, enlarged, ovary crown lobes surround an obpyramidal or obconical space leaving little room in the centre. The seeds are therefore squeezed out through the slits between the crown lobes. In a few species, however, the fruits deviate from the more typical form in that there is a wide, quadrangular space between the crown lobes (flat ovary top with style scar in the centre). The tissue of the ovary apex decomposes, and the seeds become exposed, as in a splash-cup (Stone & Weber, 1987; Weber, 1987).

A peculiarity of many species is that after fruit dehiscence the tissue of the fruit placenta disintegrates completely leaving behind a mass of vascular bundles. This is certainly a feature more typical among shrubby species, but not absent in several herbaceous ones. The seeds are tuberculate, cuneate, or oblong, but never cochleate.

#### MATERIALS AND METHODS

This work is based upon the study of herbarium specimens examined in and/or borrowed from the following herbaria: A, AAU, ABD, BKF, BM, C, E, FI, GH, HBG, K, KEP, KLU, L, NY, P, PH, SAN, SAR, SING, UPM and WU (Holmgren et al., 1990). Fieldwork was carried out in Malaysia during March and April 1995.

Measurements of the vegetative parts were taken from herbarium material and in the field whenever possible. Flowers and fruits were collected and stored in 70% alcohol, or, when not available, they were taken from dried herbarium specimens, boiled and examined using a dissecting microscope. Data on the distribution and ecology were taken from specimen labels and personal observations in the field.

For the purpose of this work, I have recognized species based on the presence of unique combinations of fixed morphological characters. As such, I have employed the phylogenetic species concept advanced by Nixon & Wheeler (1990).

#### TAXONOMIC TREATMENT

##### PHYLLAGATHIS

*Phyllagathis* Blume (1831a) 507; (1831b) 248. — Type: *Phyllagathis rotundifolia* (Jack) Blume. *Brittenia* Cogn. (1890) 515; (1891) 519; C. Hansen (1985) 171. — Type: *Brittenia subacaulis* Cogn.

*Cyanandrium* Stapf (1895) pl. 2419; Gilg (1897) 7, suppl.: 263; M.P. Nayar (1965) 501. — Type: *Cyanandrium guttatum* Stapf.

*Enaulophyton* Steenis (1932) 175, in obs., 194, 196. — Type: *Enaulophyton lanceolatum* Steenis. *Tylanthera* C. Hansen (1990a) 632. — Type: *Tylanthera tuberosa* C. Hansen.

Herbs, subcaulescent or mostly caulescent, often prostrate and rooting, rarely stoloniferous or with tubers, variously branched to unbranched, or rarely erect single-stemmed, with a basic vestiture of minute brown glands (rarely stellate) of various density on

some or all vegetative parts. *Stems* terete to subquadrangular, or rarely slightly flat, sulcate or ribbed, often prostrate and rooting, usually with an additional indumentum of rarely branched or gland-tipped hairs or bristles, internodes 0.3–6.5 cm long or in stolons to 25 cm long. *Leaves* opposite or alternate at least at the base, isomorphic, equal to subequal, rarely unequal or one leaf aborted in a pair, glabrous or with sparse long hairs, (3–)5–11(–15)-nerved, or slightly to prominently 5–7-plinerved, with 1 or 2 pairs of faint nerves in addition, at least basally, broadly ovate to elliptic, or sometimes more or less orbicular, or rarely obovate or (sub)pandurate, rarely coriaceous or bullate, base cordate to very broadly cordate or rounded, rarely narrowly rounded or cuneate or acute, apex acuminate to shortly broadly acuminate, rarely very broadly acute to rounded, margin entire, or rarely subdenticulate or subdentate to irregularly double dentate. *Petioles* present or leaves rarely sessile, usually with an additional indumentum as on stem. *Inflorescences* a terminal or rarely axillary, variously contracted thyrse, with flowers arranged in opposite or slightly displaced clusters, often with lateral scorpioid branches, or a simple or rarely compound umbel, or rarely a dense head-like aggregate of scorpioid branches, or a dichasium, or rarely reduced to a solitary flower or in pairs, peduncles sometimes with an additional indumentum of bristles, bracts subulate or bristle-like, or very broadly ovate or cordate, with minute brown glands and rarely some hairs in addition. *Flowers* actinomorphic, 4- or 5-merous, usually diplostemonous, rarely haplostemonous (only in South China and Thailand species), pedicel often with a sparse indumentum usually as petiole or hypanthium. *Hypanthium* cup-shaped, campanulate or slightly urceolate, usually subquadrangular or quadrangular, very rarely ribbed or winged, usually with minute brown glands, rarely uniseriate or stellate or sometimes gland-tipped hairs or bristles, or rarely with fleshy emergences. *Sepals* broad and short, usually triangular and keeled, often connate, with a sparse indumentum as on the hypanthium, either persistent or disappearing in the mature fruit. *Petals* oblong, ovate, elliptic, or obovate, or sometimes irregularly or broadly so, glabrous or ending with a gland of the hypanthial kind, white, pink, or purple. *Stamens* 4 (only in South China and Thailand), 8 or 10, isomorphic and equal, less often dimorphic and unequal, filaments glabrous or sometimes with sparse minute gland-tipped hairs on basal half, anthers narrowly ovate in lateral view and tapering, or rarely oblong and obtuse, often slightly curved to ventral side, usually yellow, pore one, usually more or less ventrally inclined, about as wide as apex, less often minute, pollen sacs often free basally and extended below insertion of filament, connective distinct, dorsally with a tubercle or a long spur, or rarely a flat ridge (only in Thailand), occasionally inappendiculate, ventrally inappendiculate, or with filaments, ligulate appendages or auricles. *Ovary* 4- or 5-locular, usually about half as long as hypanthium, and adnate to it for one half or to its entire length, anther pockets shallow (to half-way), or deep (to the base), crown lobes usually large and surrounding base of style, rarely absent, lobes partly to fully connate, placenta axile, protruding into locules on stalks, peltate. *Style* glabrous, stigma as wide as or narrower than apex. *Fruit* a capsule usually cup-shaped, quadrangular or pentangular, rarely urceolate, and 8–10-ribbed, or ribs absent, composed of usually swollen persistent basal part of hypanthium and capsule, persistent crown lobes usually much enlarged, wedge-like, often surrounding an obpyramidal or an obconical space, placental column with or without a beak, 4- or 5-horned or horns absent, placentae stalked, disintegrating after seed dehiscence or rarely not. *Seeds* obovate or less often oblong or cuneate, rarely ellipsoid, never



cochleate, sometimes angular, testa usually slightly to distinctly tuberculate, beak short blunt, strophiole usually dark brown.

## KEY TO THE TAXA

- 1a. Stamens 4 ..... 2  
 b. Stamens 8 ..... 3  
 2a. Leaves 25–30 by 17–20 cm; inflorescences an umbel, peduncles to 16 cm long  
 ..... 7. *P. siamensis*  
 b. Leaves 2–5 by 1–3 cm; inflorescences a scorpioid cyme, peduncles to 6 cm long  
 ..... 10. *P. tuberosa*  
 3a. Shrubs ..... 4  
 b. Herbs ..... 5  
 4a. Much branched shrubs ..... 2. *P. fruticosa*  
 b. Single-stemmed shrubs up to 2 m ..... 9. *P. tuberculata*  
 5a. Inflorescences thyrsoid ..... 6  
 b. Inflorescences umbelliform or a head-like aggregate ..... 8  
 6a. Thyrses with distinct long scorpioid branches; stems sometimes stoloniferous  
 ..... 8. *P. stolonifera*  
 b. Thyrses without branches; flowers occurring in clusters along the rachis; stems  
 never stoloniferous ..... 7  
 7a. Clusters of flowers alternate along the thyrses; stamens dimorphic 1. *P. cordata*  
 b. Clusters of flowers opposite or slightly displaced along the thyrses; stamens iso-  
 morphic ..... 3. *P. griffithii*  
 8a. Inflorescences a head-like aggregate ..... 5. *P. rotundifolia*  
 b. Inflorescences umbelliform ..... 9  
 9a. Umbels receptacled; stamens isomorphic; inflorescences and leaves displaced on  
 to carriers (phyllophores) ..... 6. *P. scortechinii*  
 b. Umbels plurinodal; stamens dimorphic; phyllophores absent .... 4. *P. hispida*

**1. *Phyllagathis cordata* Ridl. — Map 1**

*Phyllagathis cordata* Ridl. (1912) 4. — Type: *Kelsall s.n.* (holo K), Johore, Gunung Janing.

Branched herbs with minute brown glands covering all parts. *Stems* hollowed, terete, up to 20 cm long, usually thick, with 3–8 mm long retrorse hairs, some tipped with a small elongate gland. *Leaves* isomorphic, equal, broadly ovate to suborbicular, 17.5–27.5 by 13–25 cm, 7- or 9-nerved, upper surface glabrous or sometimes with sparse 1.5–3 mm long bristles, lower surface with 0.5–1.5 mm long patent hairs along nerves, base broadly cordate, apex acuminate, margin subentire or bluntly denticulate with up to 3 mm long patent hairs. *Petioles* 15–19 cm long, with up to 5 mm long thin retrorse bristles. *Inflorescences* a terminal thyrses, 30–50 cm long, with few alternate clusters of 3–6 flowers scattered along the 6.5–18 cm long rachis, peduncle 20–35 cm long, bracts scaly, less than 0.5 mm long, ending in a long bristle or reduced to bristles. *Flowers* 4-merous, pedicel from 3–5 mm long in bud up to 10 mm long in fruit. *Hypanthium* narrowly campanulate, quadrangular basally, c. 4.5 by 1.5 mm, wall thin. *Sepals* wide, triangular, disappearing in mature fruit, c. 0.6 mm long, with a cusp just below apex, shortly connate. *Petals* ovate to lanceolate, c. 5.5 by 3 mm,

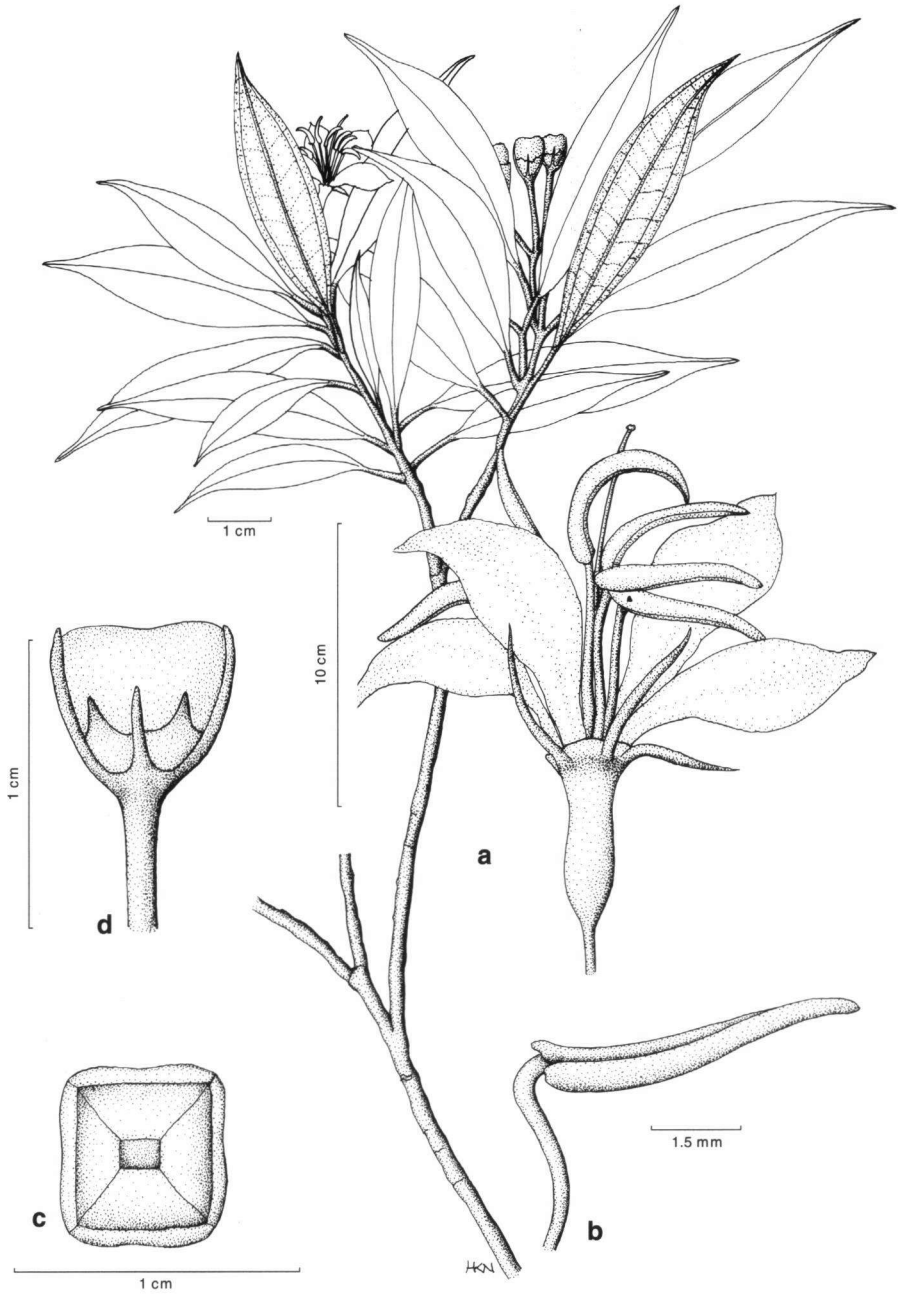


Fig. 1. *Phyllagathis fruticosa* (Ridl.) C. Hansen ex Cellin. a. Habit and flower; b. lateral view of stamen; c, d. capsule seen from the side and from above.

white. *Stamens* 8, dimorphic, unequal, filaments with a few minute glandular hairs at least close to the base, shorter ones 3 mm long, longer ones 5.2 mm long, anthers narrow, tapering distally, shorter ones 5.1–5.3 mm long, straight, longer ones 7.7–7.9 mm long, curved, pollen sacs prolonged and free at the base, connective with a short thick blunt spur, ventrally inappendiculate. *Ovary* less than half as long as the hypanthium, and adnate to it for half its length, anther pockets shallow, crown of four lobes partly connate, glabrous. *Style* c. 12 mm long, stigma subcapitulate. *Capsules* obconical cup-shaped, 4–5 by 4–5 mm, subquadrangular, with valves protruding 1–1.5 mm above the ribs, surrounding an obpyramidal space, placental column stout, shortly but widely beaked, horns absent, but with 4 tubercles, placentae disintegrating after seed dehiscence. *Seeds* obovate, c. 0.7 mm long, subtuberculate with a thick beak and a blackish strophiole in the wide raphe.

Distribution — Peninsular Malaysia (9 coll.: Johore and Pahang), endemic.

Habitat — Rocks close to streams, elevation not recorded. Flowering: June; fruiting: June to October.

Vernacular name — Kaka pullum.

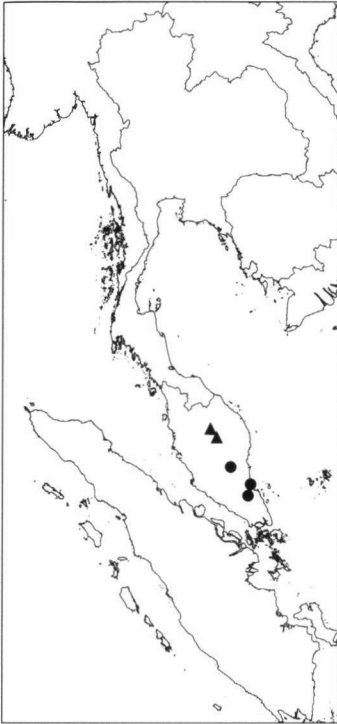
Note — One of four thyrsoid species, easily recognized by the alternate clusters of flowers along the rachis, and the long, dimorphic and unequal anthers.

## 2. *Phyllagathis fruticosa* (Ridl.) C. Hansen ex Cellin., *comb. nov.* — Fig. 1, Map 1

*Anerincleistus fruticosus* Ridl. (1908) 309. — *Perilimnastes fruticosa* (Ridl.) Ridl. (1922) 773. —

Type: *Wray & Robinson 5453* (BM, CAL not seen; lecto K), Pahang, Gunong Tahan.

Much-branched shrubs up to 1 m tall, glabrous or with minute brown glands, often only when young, branchlets subquadrangular, sulcate on two opposed sides, and usually 4-ribbed when very young, terete when older. *Leaves* isomorphic, subequal, elliptic-ovate or more often elliptic, 2.8–7.5(–14) by 0.6–2.8(–4.2) cm, often more or less coriaceous, 3-nerved, sometimes with an additional pair of faint nerves close to margin, nerves indistinct on upper leaf surface, base usually acute, apex acuminate, margin entire. *Petioles* 0.4–2(–2.4) cm. *Inflorescences* a terminal simple dichasium or sometimes reduced to a solitary flower, peduncle 0.4–1 cm long, subtended by a pair of small ordinary leaves, c. 20 by 5 mm, or more often by subulate caducous bracts to 4.5 mm long. *Flowers* 4-merous, pedicel from 5 mm long in flower to 17 mm long in fruit. *Hypanthium* slightly urceolate, 5–10 by 1.5–2.7 mm, quadrangular, with 4 ribs or low wings. *Sepals* low, triangular, 4–7 mm long, free, with a keel extended far beyond apex. *Petals* ovate to elliptic, acuminate, 8.5–16 by 3.5–5 mm, white or pale pink. *Stamens* 8, isomorphic, subequal, filaments 5–7 mm long, glabrous, anthers narrowly ovate, slightly S-shaped or bending forward only apically, 5.3–6.6 mm long, yellow, pollen sacs free, connective distinct, with a pendent 0.2–0.3 mm long dorsal spur, ventrally inappendiculate. *Ovary* half as long as hypanthium, adnate to it for its whole length, anther pockets shallow, crown lobes fully connate. *Style* 14–22 mm long. *Capsules* obpyramidal cup-shape, 5.5–10 by 4.6–5 mm, 8-ribbed, valves protruding up to 2.5 mm, placenta column beaked, horns slightly spreading then curved inwards, c. 0.5 mm long, placentae disintegrate after seed dehiscence. *Seeds* cuneate, c. 0.8 mm long, slightly tuberculate, with a very short beak, strophiole to base of beak, wide basally.



Map 1. Distribution of *Phyllagathis cordata* Ridl. (●) and *P. fruticosa* (Ridl.) C. Hansen ex Cellin. (▲).

Distribution — Peninsular Malaysia (10 coll.: Kelantan and Pahang), endemic.

Habitat — On slopes by streams in forests at 700–2000 m elevation. Flowering: February, June, July, August; fruiting: August, September.

Note — *Phyllagathis fruticosa* is unusual in this region for being a much branched shrub with dichasial inflorescence, often reduced to solitary flowers. It appears to be more closely related to Chinese taxa. I agree with Hansen to form a new combination as all morphological characters fit well within the generic boundaries.

### 3. *Phyllagathis griffithii* (Hook.f. ex Triana) King — Fig. 2, Map 2

*Phyllagathis griffithii* (Hook.f. ex Triana) King (1900) 45. — *Allomorpha griffithii* Hook.f. ex Triana (1871) 74. — Type: *Griffith s.n.* (BM, BR not seen; lecto K), Malacca.

Creeping herbs, little-branched, 30–40 cm high, with minute brown glands on all vegetative parts. *Stems* terete, up to 12 cm long, often thick, sometimes gnarled. *Leaves* often a single pair, isomorphic, subequal, very broadly ovate, elliptic or orbicular, 12–25 by 8.5–22 cm, coriaceous, 5- or -7-nerved, secondary and tertiary nerves conspicuous, both surfaces glabrous, lower surface often red, base broadly cordate, apex broad, acute to rounded to retuse-acuminate, margin entire, revolute. *Petioles* (5–) 10–20(–30) cm long, glabrous. *Inflorescences* a 1–3 axillary or subterminal thyrses, 18–39 cm long, rachis with sessile opposite or slightly displaced clusters of flowers arranged along 5–8 nodes, 1–3 cm apart, peduncle 14–28 cm long, often with a node without leaves or with rudimentary leaves 1–5 cm from the base, bracts subulate or

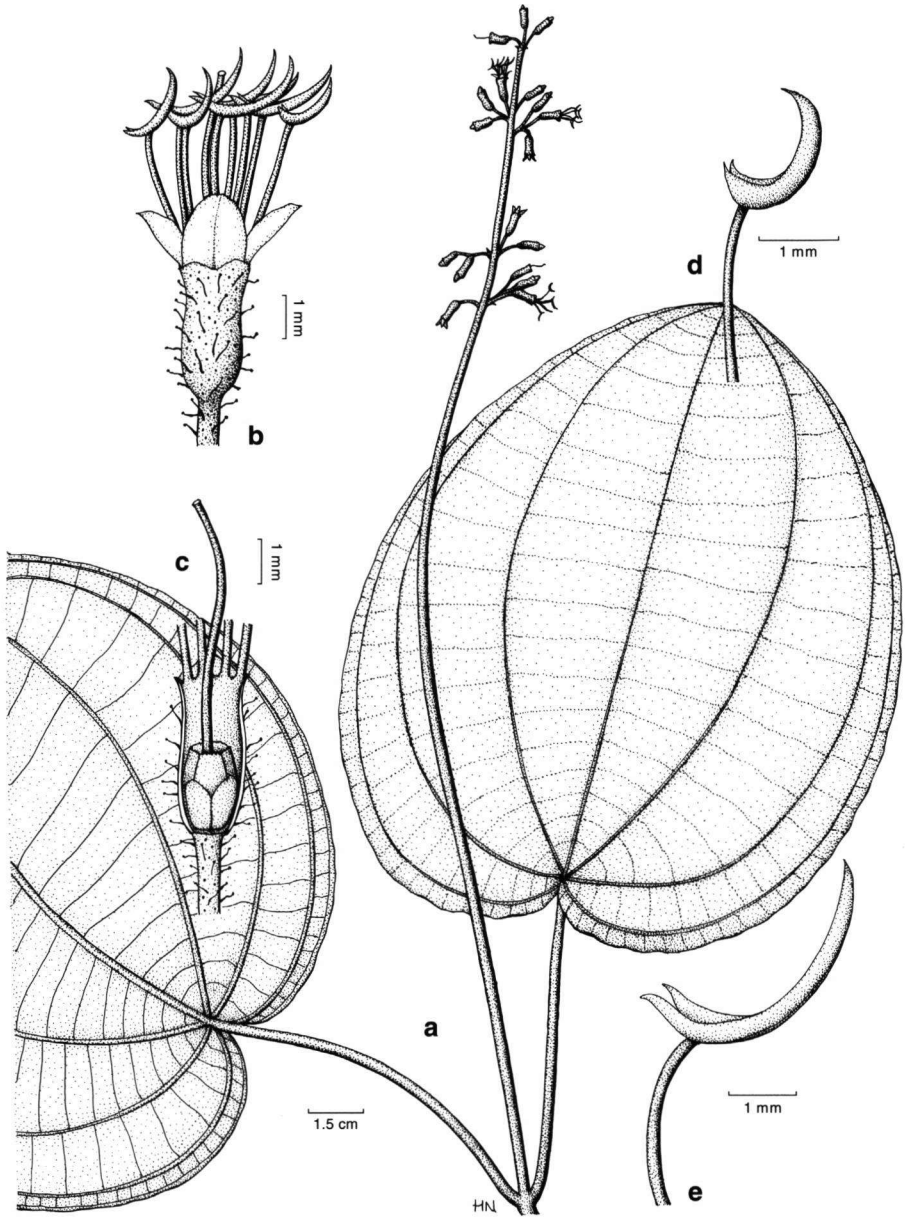
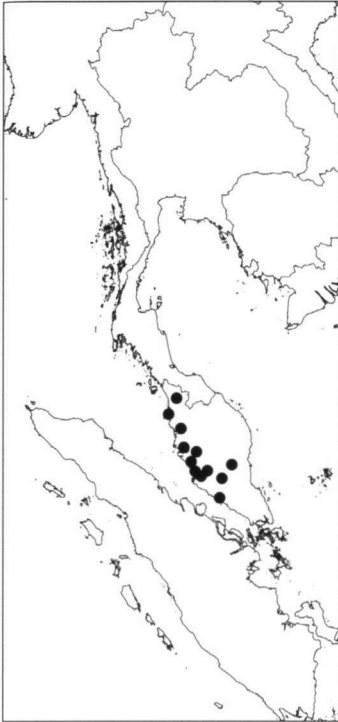


Fig. 2. *Phyllagathis griffithii* (Hook.f. ex Triana) King. a. Habit; b. flower; c. longitudinal section of a flower showing pistil and bases of filaments; d. short stamen; e. long stamen.



Map 2. Distribution of *Phyllagathis griffithii* (Hook. f. ex Triana) King.

bristle-like, up to 0.5 mm long. *Flowers* 4-merous, pedicel 3.5–5.5 mm long. *Hypanthium* narrow, tubular or slightly urceolate, sometimes with constriction below the middle, subquadrangular, 3–4.7 by 1–2 mm, with often sparse minute brown glands and patent 0.1–0.3 mm long gland-tipped hairs. *Sepals* very low and wide, free, triangular or rounded, with a thick low keel, clothed as the hypanthium. *Petals* irregularly oblong, thick, 1.6–2.1 by 0.9–1.6 mm, white. *Stamens* 8, isomorphic, unequal, filaments 4–4.4 mm in short stamens and 4.2–4.9 mm in long stamens, anthers narrow, much curved to ventral side, shorter ones 2.5–3.5 mm long, inappendiculate, with apical pore oblique on dorsal side of apex, longer ones 4.5–5.5 mm long, inappendiculate, pollen sacs prolonged 0.5–1.6 mm below insertion of filament and free at the base, connective distinct, apical pore oblique on ventral side. *Ovary* about half the length of the hypanthium and adnate to it for half its length, top of ovary much depressed and crown large, lobes almost fully connate, 4 shallow and 4 deep anther pockets, placentae with stalks. *Style* 6.5–7.8 mm long. *Capsules* not seen.

Distribution — Peninsular Malaysia (30 coll.: Kedah, Melaka, Negeri Sembilan, Pahang, Perak, Selangor), endemic.

Habitat — Primary forest, in shade, on slopes by streams, 60–670 m elevation. Flowering: April to November.

Vernacular names — Kapo-Kapo, Kurukap Rimbah, Tutup Bumi Rimbah.

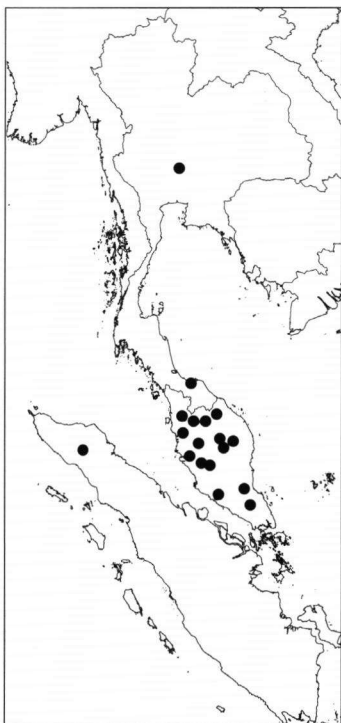
Note — Another thyrsoid species, *P. griffithii* can be recognized by having no other indumentum than brown glands and a slender inflorescence with opposite flower clusters. Additionally, the anthers are much curved with long pollen sacs free at the base.

#### 4. *Phyllagathis hispida* King — Fig. 3, Map 3

*Phyllagathis hispida* King (1900) 69 — Types: Ridley 2236 (lecto SING, designated here), Scortechini s.n. (BM), Wray 1021, 1602, 3519 (SING).

*Phyllagathis sumatrana* Bakh.f. (1943) 268. — Type: Pringo Atmodjo 525 (holo L), Gajoe en Alas Landen, Batak, Kali Renoeng.

Acaulescent or subcaulescent, rarely branched herbs 25–60 cm high, with minute uni-seriate glandular hairs sparse on all parts and/or bristles. *Stems* up to 13 cm long, thick, with dense up to 10 mm long patent, rarely branched bristles. *Leaves* two to four, isomorphic, equal to subequal, broadly ovate, 10–25 by 6–18 cm, (5–)7–11-nerved, rarely slightly plinerved, secondary nerves conspicuous, upper surface with sparse 0.5–2 mm long patent bristles, lower surface with patent 1–4 mm long branched and unbranched hairs, very rarely hairs tipped with a small elongated gland, base very broadly cordate to subcordate, apex broadly, shortly acuminate, margin subdentate or irregularly dentate to double-dentate, rarely entire, with sparse 1–4 mm long thin bristles. *Petioles* 7–30 cm long, usually with sparse to dense 2–12 mm long thin, slightly retrorse, branched or unbranched bristles. *Inflorescences* an axillary umbel, 16–32 cm long, peduncle 14.5–30 cm long, with 1–4.5 mm long patent thin hairs tipped with a small narrow elongate gland, bracts absent or subulate or linear, 0.5–3 mm long, ending in an up to 2 mm long thin bristle and sometimes with a few lateral ones in addition. *Flowers* 4-merous, pedicels from 6 mm long in flower up to 18 mm long in fruit, clothed as the peduncle. *Hypanthium* narrow, tubular, slightly urceolate, with



Map 3. Distribution of *Phyllagathis hispida* King.

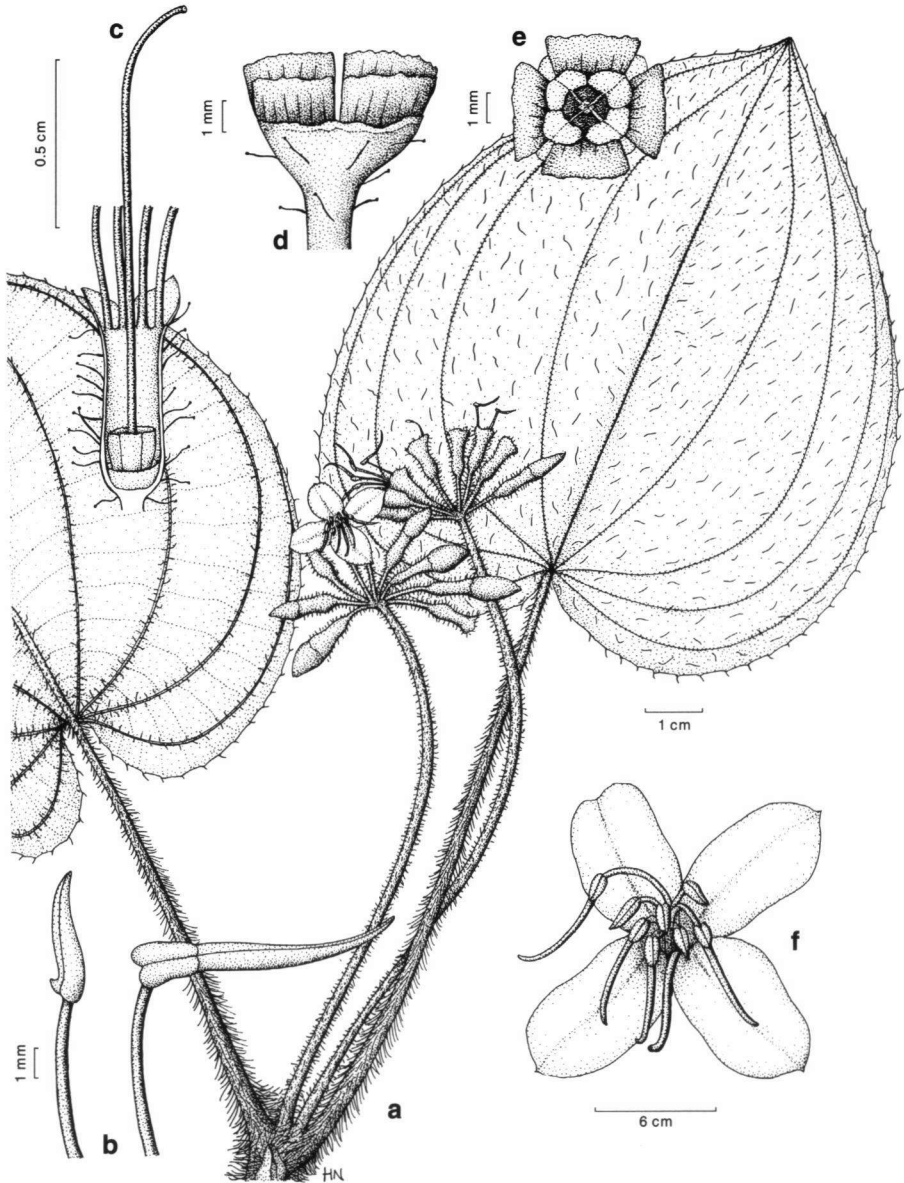


Fig. 3. *Phyllagathis hispida* King. a. Habit; b. inner and outer stamens; c. longitudinal section of a flower showing pistil and bases of four filaments; d, e. capsule seen from the side and from above; f. flower from above.

constriction below the middle, subquadrangular, 7–9 by 1.2–1.5 mm, often with patent 0.5–2 mm long hairs tipped by a narrow elongate gland. *Sepals* very low and wide, triangular, 0.8–1.7 mm high and partly connate, slightly keeled, clothed as hypanthium, perishing with the tubular part of hypanthium shortly after flowering. *Petals* elliptic,



thin, c. 8.5 by 5.5 mm, white or pinkish. *Stamens* 8, dimorphic, unequal, filaments 7–9 mm long, anthers narrow, shorter ones slightly curved, 4.5–5.5 mm long, yellow, longer ones S-shaped, 8–10 mm long, base yellow, top violet, pollen sacs in both extended below insertion of filament and free at the base, connective distinct along whole length of anthers except on basal extension, dorsal appendage a flat spur narrow and curved upwards in shorter anthers, wide and bending backwards or upwards in larger anthers, ventrally inappendiculate, pore half as wide as apex. *Ovary* about one third the length of hypanthium, and adnate to it for half its length, anther pockets shallow, crown lobes only shortly connate, large and wide, placentae stalked. *Style* 16–18 mm long. *Capsules* obconical cup-shaped, 4–6 by 4.5–5.5 mm, crown lobes protruding for 1–1.5 mm and surrounding an obconical apical depression, placental column very shortly beaked, horns thick, acute, c. 0.5 mm long, placentae disintegrating after seed dehiscence. *Seeds* cuneate, c. 0.7 mm long, subtuberculate, with a blackish strophiole basally in raphe.

Distribution — Thailand (2 coll.: Central and Peninsular), Peninsular Malaysia (47 coll.: Johore, Kedah, Kelantan, Pahang, Perak, Selangor), Singapore (introduced, see *Sinclair 1940*), Indonesia (1 coll.: Sumatra).

Habitat — Damp places in primary forest at 30–2200 m elevation. Flowering: March to November; fruiting: April to December.

Note — Easily recognized by its umbellate inflorescence and long, branched bristles on the petiole. Additionally, the leaf margins are usually dentate.

##### 5. *Phyllagathis rotundifolia* (Jack) Blume — Fig. 4, Map 4

*Phyllagathis rotundifolia* (Jack) Blume (1831a) 507; (1831b) 248. — *Melastoma rotundifolia* Jack (1825) 11. — Type: *Bunnemeijer 8347* (neo K, designated here; L), Sumatra, W Kust, Koerintji meer.

*Phyllagathis decipiens* Bakh.f. (1943) 267. — Type: *De Voogd 584* (holo L), Sumatra, Benkoelen, Balai.

*Phyllagathis praetermissa* A. Weber (1990) 21. — Type: *Weber 840813* (holo WU), Malaysia, Selangor/Pahang, Fraser's hill.

Cauliscent herbs with an indumentum of stellate minute brown glands on all vegetative parts and on stem, peduncle and petioles, usually with dense to sparse 2–8 mm long slightly retrorse bristles also clothed with stellate minute glands. *Stems* usually erect only distally, otherwise creeping and rooting, terete, subquadrangular or often slightly flat or thick, up to 70 cm long. *Leaves* isomorphic and equal to rarely subequal, occasionally one leaf rudimentary and abortive, broadly ovate or elliptic, or sometimes suborbicular, or rarely obovate, 5–45 by 3.5–35 cm, 5–9-nerved, sometimes middle pair of nerves diverging up to 2.5 cm from leaf base, upper surface becoming glabrescent, sometimes with scattered 1–3 mm long patent bristles, and occasionally with white spots on juvenile leaves, lower surface rarely with a few bristles on longitudinal nerves, base very broad, rounded to cordate or subcordate, sometimes slightly decurrent, apex usually broad and shortly acuminate, margin entire or inconspicuously denticulate to rarely bluntly dentate, glabrous. *Petioles* 2–14(–22) cm long, narrowly sulcate, bristles sparse to dense, or absent. *Inflorescences* 2–8(–12) cm long, with an involucre of 2–6 usually large bracts subtending an umbel or a variable number (more than 10 observed) of up to 2 cm long, densely scorpioid flowering branches, springing

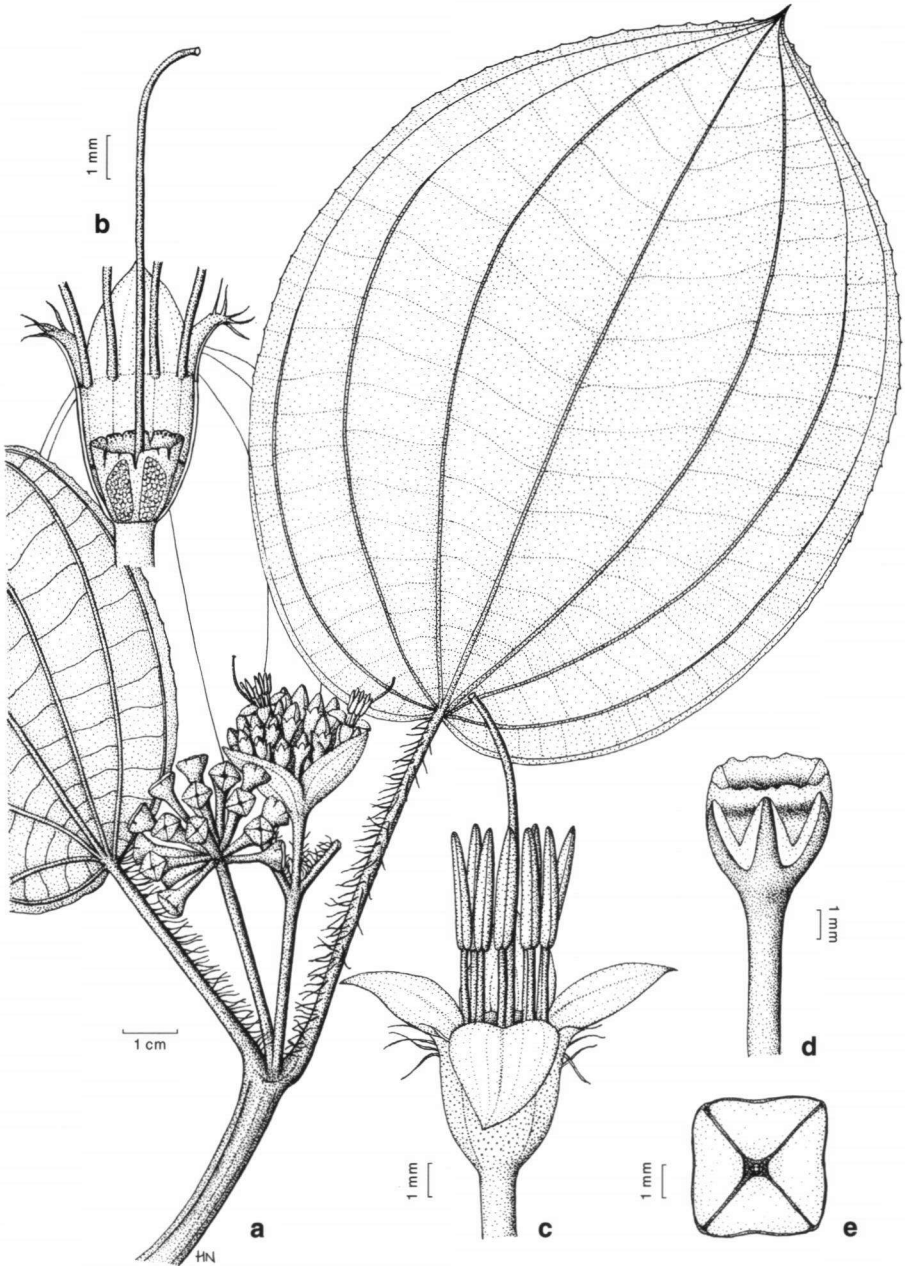
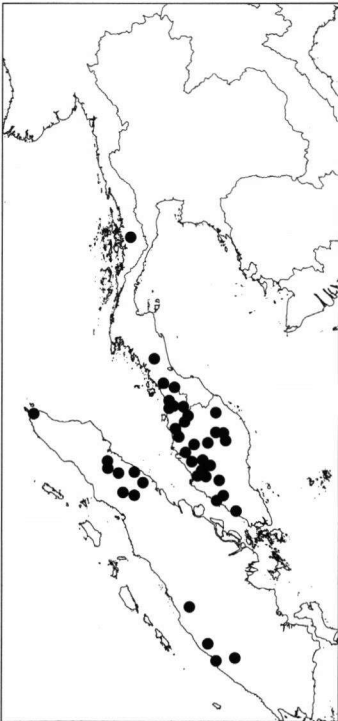


Fig. 4. *Phyllagathis rotundifolia* (Jack) Blume. a. Habit; b. longitudinal section of a flower showing pistil and bases of four filaments; c. flower; d, e. capsule seen from the side and from above.

from the widened tip of the peduncle, peduncle 2–5.5(–9.5) cm long, bracts very broad, usually ovate to cordate, 5–30 by 5–30 mm, longitudinal nerves usually distinct, often with marginal short bristles. *Flowers* 4-merous, or occasionally 5-merous, pedicel from 4 mm long in flower up to 12 mm long in fruit. *Hypanthium* cup-shaped, urceolate or campanulate, 4–9 by 2–3.5 mm, quadrangular and usually a few 1–3 mm long retrorse bristles at transition to sepals. *Sepals* broad, triangular, or rarely crescent-shaped, up to 3 mm long including the conspicuous long-extended keel, partly connate, with sparse stellate minute brown glands and with a few conspicuous bristles on keel especially distally. *Petals* pink or purple, broadly elliptic, symmetrical, c. 9 by 5.5 mm. *Stamens* 8–10, isomorphic, equal or almost, filaments 4.5–7.5 mm long, anthers narrow, oblong or ovate, obtuse and curved, 2.7–7.2 mm long, base of pollen sacs free, 0.2–0.4 mm, yellow or less often purple, dorsally with a tubercle or a very short spur, ventrally inappediculate, pore truncate or slightly oblique on ventral side of apex. *Ovary* about half as long as hypanthium, and partially adnate to it, anther pockets shallow, crown lobes fully connate, with minute brown glands on edge. *Style* 11–19 mm long. *Capsules* obpyramidal cup-shaped, 4–7 by 4–5 mm, valves only slightly longer than the hypanthium, placental column unbeaked, with 4 widely spaced short slender horns. *Seeds* obovate, slightly angular, c. 0.5 mm long, tuberculate.

Distribution — Indonesia (31 coll.: Sumatra), Peninsular Malaysia (87 coll.: Johore, Kedah, Kelantan, Melaka, Negeri Sembilan, Pahang, Perak, Selangor), Burma (1 coll.: Tanintharyi) and Thailand (2 coll.: Songkhla and Yala).



Map 4. Distribution of *Phyllagathis rotundifolia* (Jack) Blume.

Habitat — On ridges and slopes in damp shady places in forests at 20–1400 m elevation. Flowering and fruiting: all year around.

Vernacular names — Banau, Banal Hutan, Poko Fatimah.

Uses — A decoction of leaves is used to cure fever.

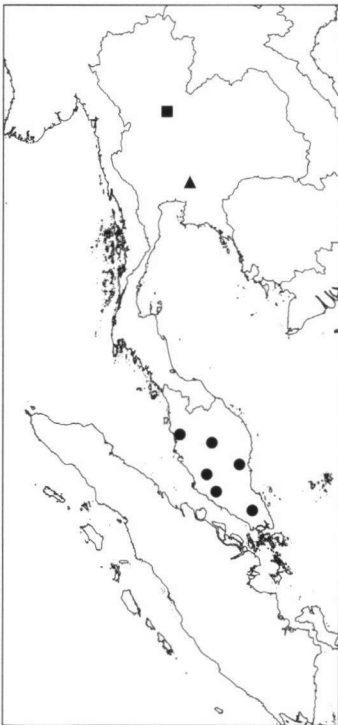
Notes — The original type, *Jack s.n.*, Musi Country, in the interior of Sumatra, was lost in a shipwreck, therefore a neotype was selected.

Forming extensive carpets in the shady understory of primary evergreen forest, the Elephant's Footprint is one of the most conspicuous forest floor species in Peninsular Malaysia. The inflorescence type is unique in the genus in having a much contracted head-like thyrses with a scorpioid flower arrangement on the short branches.

## 6. *Phyllagathis scortechinii* King — Map 5

*Phyllagathis scortechinii* King (1900) 45. — Types: *King's coll.* 4287 (FI, GH; lecto K, selected here; L), Perak, Larut, Gopeng, *Ridley* 7317 (K), Selangor, *Scortechini* 269 (BM, K, P), Perak.

Cauliscent herbs, up to 90 cm high, with usually dense minute brown glands on all parts or absent on leaves above, and with no other indumentum. *Stems* terete, 13 cm long. *Leaves* isomorphic and equal in pairs, very broad, ovate, or more often elliptic or orbicular, sometimes broader than long, 12–25 by 12–23 cm, 5–9-nerved, coriaceous, glabrous, base very broadly cordate, apex broadly rounded and abruptly tapering into a short acuminate tip, margin entire, rarely subdenticulate. *Petioles* 10–23 cm



Map 5. Distribution of *Phyllagathis scortechinii* King (●), *P. siamensis* Cellin. & S.S. Renner (▲) and *P. tuberosa* (C. Hansen) Cellin. & S.S. Renner (■).

long. *Inflorescences* displaced onto phyllophores, with flowers in a dense umbel on distal 3.5–7 mm wide hemispheric swelling of peduncle, peduncle 17.5–30 cm long. *Flowers* 4-merous, or occasionally 5-merous, pedicel 3.5–6 mm long, 9–10 mm long in fruit, bracts subtending pedicels rudimentary, bristle-like, less than 0.5 mm long. *Hypanthium* narrow, slightly urceolate, subquadrangular, 5.5 by 1.5 mm. *Sepals* rounded, c. 1 mm long, thick, and completely free. *Petals* very broadly ovate, c. 2 by 2.5 mm, thick, pink. *Stamens* 8, isomorphic, unequal, filaments c. 4 mm long, glabrous or with sparse stipitate glands, anthers narrowly ovate, c. 5 mm long, pollen sacs prolonged 0.5 mm below insertion of filaments, connective distinct along whole anther except basal prolongation, with an 0.1–0.2 mm long blunt dorsal spur, ventrally inappendiculate. *Ovary* about half length of hypanthium, partially adnate to hypanthium, anther pockets shallow, top of ovary much depressed, crown of 4 large, partly connate lobes with minute brown glands on edge, placentae narrowly stalked. *Style* c. 12 mm long. *Capsules* obconical cup-shaped, c. 6 by 5 mm, hypanthium swollen, smooth, placenta column with a beak widening into a subspheric head, horns absent, placentae disintegrating after seed dehiscence. *Seeds* obovate, c. 0.5 mm long, slightly angular, dorsally tuberculate, beak slightly wide, strophiole thick basally, thin apically at base of beak.

Distribution — Peninsular Malaysia (7 coll.: Negeri Sembilan, Johor, Pahang, Perak, Selangor), endemic.

Habitat — Hills, open jungle at 200 m elevation. Flowering and fruiting: May, June.

Note — *Phyllagathis scortechinii* has no indumentum other than minute brown glands. The inflorescence is umbellate, but it differs from the other umbellate species in having a hemispheric swelling at the most distal part of the peduncle from which the flower branches arise. Additionally, the inflorescences are displaced onto foliar carriers called phyllophores (Weber, 1982).

## 7. *Phyllagathis siamensis* Cellin. & S.S. Renner — Fig. 5, Map 5

*Phyllagathis siamensis* Cellin. & S.S. Renner (1997) 109. — *Tylanthera cordata* C. Hansen (1990a) 634. — Type: Larsen et al. 3402 (holo AAU; BKF, C), Nakhon Nayok, Sarika waterfall.

Acaulescent herbs, 30–40 cm tall, sparsely hairy. *Leaves* one or two, broadly ovate, 25–30 by 17–20 cm, 9(–11)-nerved, both surfaces glabrous, base broadly cordate, apex acuminate, margin dentate. *Petioles* about 14 cm long, densely covered by short hairs. *Inflorescences* a many-flowered umbel, peduncle 9–15 cm long, sparsely covered by hairs arranged in two longitudinal rows. *Flowers* 4-merous, bracts subulate and minute, pedicels 5–7 mm long. *Hypanthium* campanulate, about 2.5 mm long, sparsely hairy, calyx teeth about 0.7 mm long. *Petals* broadly ovate, known only from buds, pink. *Stamens* 4, isomorphic, filaments 2.9 mm long, anthers about 2 mm long, base slightly bilobed, connective dorsally enlarged into a flat ridge. *Ovary* almost as long as the hypanthium, 4-locular, fully adnate to the hypanthium, crowned by 4 large quadrangular lobes surrounding the style base. *Capsules* subquadrangular, about 3 by 3 mm, placentae stalked. *Seeds* obovate, c. 0.4 mm long, testa tuberculate.

Distribution — Thailand (1 coll.: Saraburi).

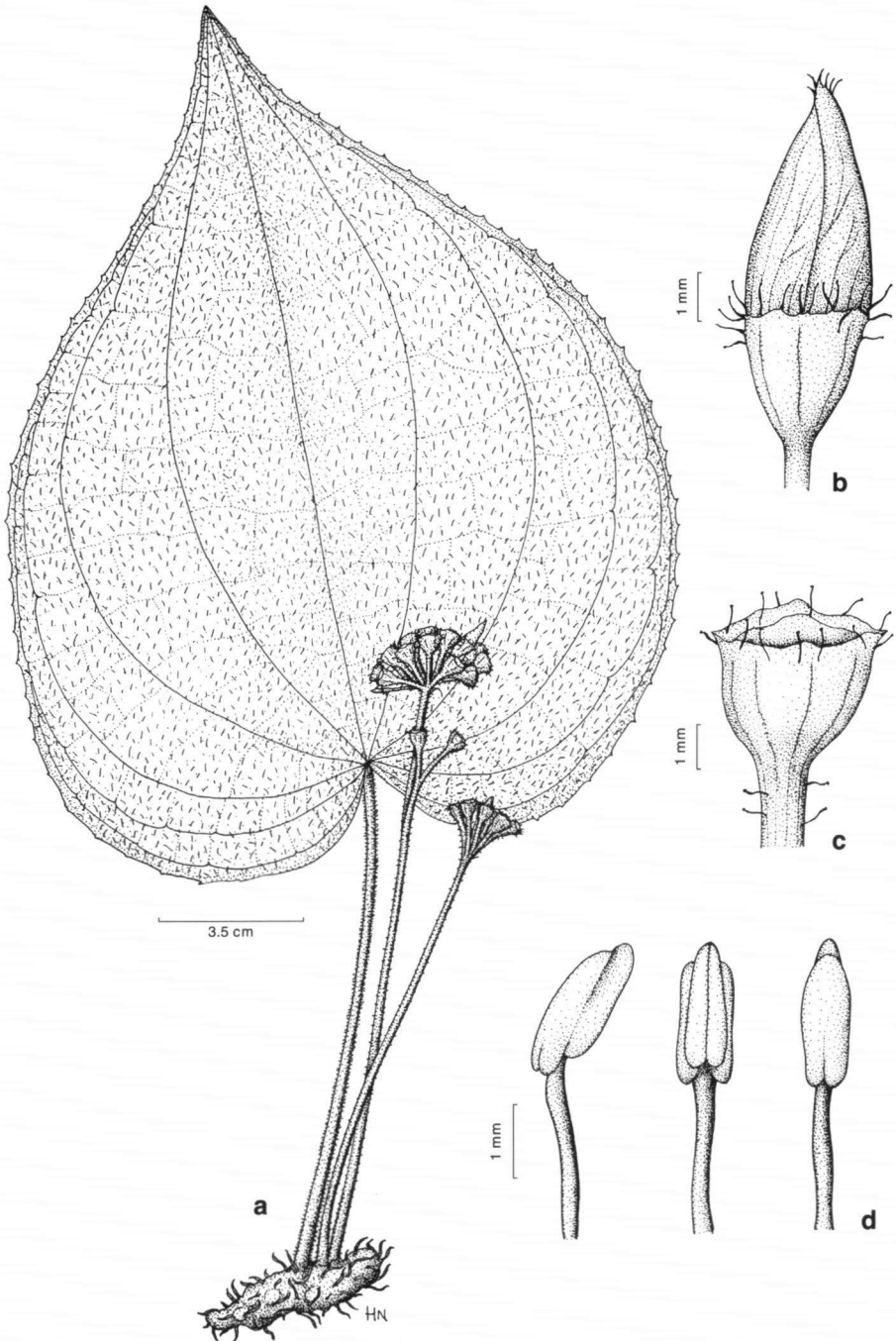


Fig. 5. *Phyllagathis siamensis* Cellin. & S.S. Renner. a. Habit; b. flower bud; c. capsule; d. lateral, ventral and dorsal view of stamen.

Habitat — Along streams at elevations below 400 m. Flowering and fruiting: known in August.

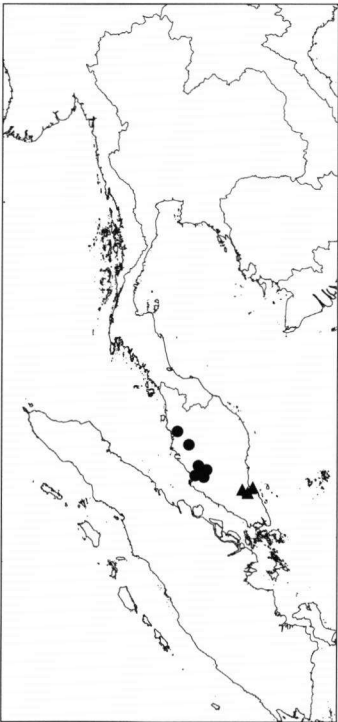
Note — Easily recognized by the one or rarely two large and deeply cordate leaves.

### 8. *Phyllagathis stolonifera* Kiew — Map 6

*Phyllagathis stolonifera* Kiew (1987) 224. — Type: *Kiew 2190* (holo UPM), South Plateau, Endau, Johore .

*Phyllagathis maxwellii* B.C. Stone & A. Weber (1987) 307. — Type: *Stone 11629* (holo KLU; PH), Pahang, Endau-Rompin area, near summit of Bukit Peta on the Johore boundary.

Caulescent herbs, 25–40 cm high, sometimes producing stolons up to 1 m long. *Stems* with minute brown glands and dense 0.3–1 mm long usually appressed brown hairs, internodes of stolons up to 25 cm long. *Leaves* isomorphic, broadly ovate to orbicular, very rarely bullate, 6–23 by 4–16.5 cm, 7- or -9-nerved, above with sparse minute brown glands or glabrous, below clothed with 0.1–0.6 mm appressed or patent brown hairs, base cordate, apex shortly broadly acuminate, margin entire, with a few hairs. *Petioles* (2.5–)9–17 cm long, with minute brown glands and clothed as leaves. *Inflorescences* a thyrse, 15–40 cm long, with quaternate branches 2–4 cm apart, branches up to 3 cm long, densely scorpioid, whole inflorescence with minute brown glands and 0.1–0.5 mm long appressed or ascending brown hairs, peduncle 12–30 cm long, bracts absent. *Flowers* 4-merous, pedicel from 3 mm long in flower up to 5.5 mm long in fruit, usually with patent 0.3–0.5 mm long gland-tipped hairs. *Hypanthium* cup-shaped,



Map 6. Distribution of *Phyllagathis stolonifera* Kiew (▲) and *P. tuberculata* King (●).

1.6–1.8 by 1.4–1.8 mm, with minute brown glands and also with bristles of all sizes up to 0.4 mm long, and usually c. 0.3 mm long patent thin gland-tipped hairs. *Sepals* very low and wide, 0.5–1 mm long, free, slightly spreading, with a low dorsal keel pointed into a short bristle, clothed as hypanthium. *Petals* irregularly oblong, c. 3 by 4 mm, apex acute, white. *Stamens* 8, isomorphic, equal, filaments 2.2–3 mm long, anthers narrowly ovate, curved to ventral side, 1.6–2 mm long, white to pale purple, connective distinct with a short blunt dorsal spur and no ventral appendages, pore minute. *Ovary* about two thirds length of hypanthium, and adnate to it for half its length, conspicuously with 0.1–0.2 mm long hairs on edge tipped with a relatively large spherical gland, crown lobes partly connate, with minute glandular hairs, anther pockets shallow. *Style* c. 3 mm long. *Capsules* widely cup-shaped, c. 3 by 3–4.5 mm, faintly 8-ribbed, with valves protruding c. 0.5 mm and surrounding an obconical space, hypanthium non-ribbed and non-swollen, crown protruding c. 1 mm, placenta column wide basally, beaked, without horns, placentae disintegrating after seed dehiscence. *Seeds* obovate, c. 0.6 mm long, smooth with a narrow beak and strophiole.

Distribution — Peninsular Malaysia (8 coll.: Johore and Pahang), endemic.

Habitat — In shade, in heath forest, among moss on raised bank of stream, or on rock faces, at 700 m elevation. Flowering and fruiting: known in April and October.

Note — *Phyllagathis stolonifera* is clearly distinguished from other thyrsoid species in having an inflorescence with quaternate, densely scorpioid branches. Additionally, its stoloniferous habit is unique in the genus.

### 9. *Phyllagathis tuberculata* King — Map 6

*Phyllagathis tuberculata* King (1900) 44. — Types: *King's coll.* 7233 (BM; lecto K (Weber, 1987)), Perak, *Scortechini s.n.* (K), Perak.

*Phyllagathis magnifica* A. Weber (1987) 189. — Types: *Robinson s.n.* 6-2-1913, (holo K; SING), Pahang, Gunung Mengkuang.

*Phyllagathis stonei* A. Weber (1987) 192. — Type: *Weber & Anthonysamy* 840712-3/1 (holo WU), Pahang, Genting Highlands.

Erect single-stemmed shrubs, 50–200(–250) cm high. *Stems* 1–2 cm thick, herbaceous apically with minute brown glands, woody and glabrous. *Leaves* crowded apically, obovate to lanceolate, sometimes elliptic, 30–50 by 10–25 cm, 5–9-plinerved with upper pair diverging approximately at middle of blade, and with a few additional pairs of fainter nerves in narrow part, membranaceous with minute brown glands, upper surface with sparse 1–3 mm long bristles, lower surface with 0.3–4 mm long patent bristles mainly on nerves, base truncate to attenuate, often tapering along petiole, apex acuminate, margin entire or obscurely denticulate, with distant 1–3 mm long hairs. *Petioles* 0–10 cm long, covered with bristly hairs up to 10 mm long. *Inflorescences* a compound or simple umbel, peduncle 3.5–20 cm long, with very sparse minute brown glands, often with a scattered to dense indumentum of brown hairs, branches (primary rays) 3.5–5 cm long, subglabrous, bracts about as wide as long, with faint longitudinal nerves, glabrous or with sparse minute brown glands, those of involucre c. 11 mm long and those of involucel c. 4 mm long. *Flowers* 4-merous, from 10 to numerous, pedicels from 10 mm long in flower up to 18 mm long in fruit, magenta, glabrous. *Hypanthium* cylindrical to ovoid or hemispherical, 6–9 by 2.5–3 mm, covered with knob-like or cylindrical stalked tubercles. *Sepals* triangular, 1–2.5



mm long, shortly connate, with a dorsal keel ending in a glandular disc. *Petals* elliptic, c. 8 by 4–5 mm, thin, acuminate, each ending in a reduced gland of hypanthial kind, pinkish. *Stamens* 8, dimorphic, unequal, 7–11 mm long, anthers narrow, tapering, shorter ones straight, c. 7 mm long, longer ones curved to ventral side, c. 11 mm long, pollen sacs in both extended below insertion of filament, 0.1–0.2 mm in shorter ones, c. 1.1 mm in longer ones, both yellow, connective distinct, dorsally with c. 0.2 mm long spur in shorter anthers, and with an inconspicuous tubercle in longer ones, both kinds inappendiculate ventrally, pore elliptic, large. *Ovary* with locules extended to top of crown, half as long as hypanthium, and adnate to it for half its length, anther pockets deep, crown lobes fully connate, glabrous. *Style* 17–18 mm long. *Capsules* cup-shaped, 6.5–7 by 5.5–6 mm, sepalous rim not widened but tightened over top of capsule, with a non-swollen 8-ribbed persistent part of hypanthium and accrescent, wedge-like valves protruding about 2 mm. *Seeds* oblong to obovate, c. 0.6 mm long, testa tuberculate, strophiole from base to beak, widest basally.

Distribution — Peninsular Malaysia (22 coll.: Pahang, Perak, Selangor), endemic.

Habitat — Damp rocks with scarcely any soil, 300–1900 m elevations. Flowering: February to October; fruiting: July to February.

Note — Easily recognized by its very tall, single-stemmed, erect habit, strongly plinerved leaves, and compound umbellate inflorescence, sometimes reduced to a simple umbel. Additionally, the conspicuous hypanthial emergences are rare to find in other species.

#### 10. *Phyllagathis tuberosa* (C. Hansen) Cellin. & S.S. Renner — Fig. 6, Map 5

*Phyllagathis tuberosa* (C. Hansen) Cellin. & S.S. Renner (1997) 109. — *Tylanthera tuberosa* C. Hansen (1990a) 632. — Type: Larsen et al. 1105 (holo AAU; BKF, C), Phitsanulok, Phu Mieng Mt.

Tiny acaulescent herbs, 3–8 cm tall, sparsely hairy, with a tuberous rhizome. *Leaves* one to three (in the single specimen known), ovate, 2–5 by 1–3 cm, membranaceous, indistinctly 3–5 nerved, both surfaces loosely pilose, base truncate or slightly irregularly subcordate, apex acute, margin entire, finely ciliate. *Petioles* reddish, 1–3 cm long, sparsely pilose. *Inflorescences* a scorpioid cyme with 3–7 flowers, peduncle 2–6 cm long, sparsely pilose. *Flowers* 4-merous, subtended by two linear bracts about 1 mm long, pedicels about 4 mm long. *Hypanthium* campanulate, 1 mm long, sparsely covered with long hairs, calyx lobes about 0.2–3 mm long, acuminate. *Petals* ovate, 3.5 mm long, acute, pink. *Stamens* 4, isomorphic, filaments 1.3 mm long, anthers 0.6–0.7 mm long, connective with a small dorsal appendage. *Ovary* 4-locular, 0.8–1 mm long, almost completely adnate to the hypanthium, apically rounded. *Capsules* campanulate, about 1.5 mm long and wide, placentae stalked. *Seeds* ellipsoid, c. 0.3 mm long, testa tuberculate.

Distribution — Thailand (1 coll.: Phitsanulok).

Habitat — Growing on rocks by a stream in evergreen forest. Only known from the type, which was collected at 700 m elevation. Flowering and fruiting: known in July.

Note — One of the tiniest species in the genus, *Phyllagathis tuberosa* is unique in having tuberous rhizomes, a character found in other genera of the Sonerileae (e.g. *Sonerila*).

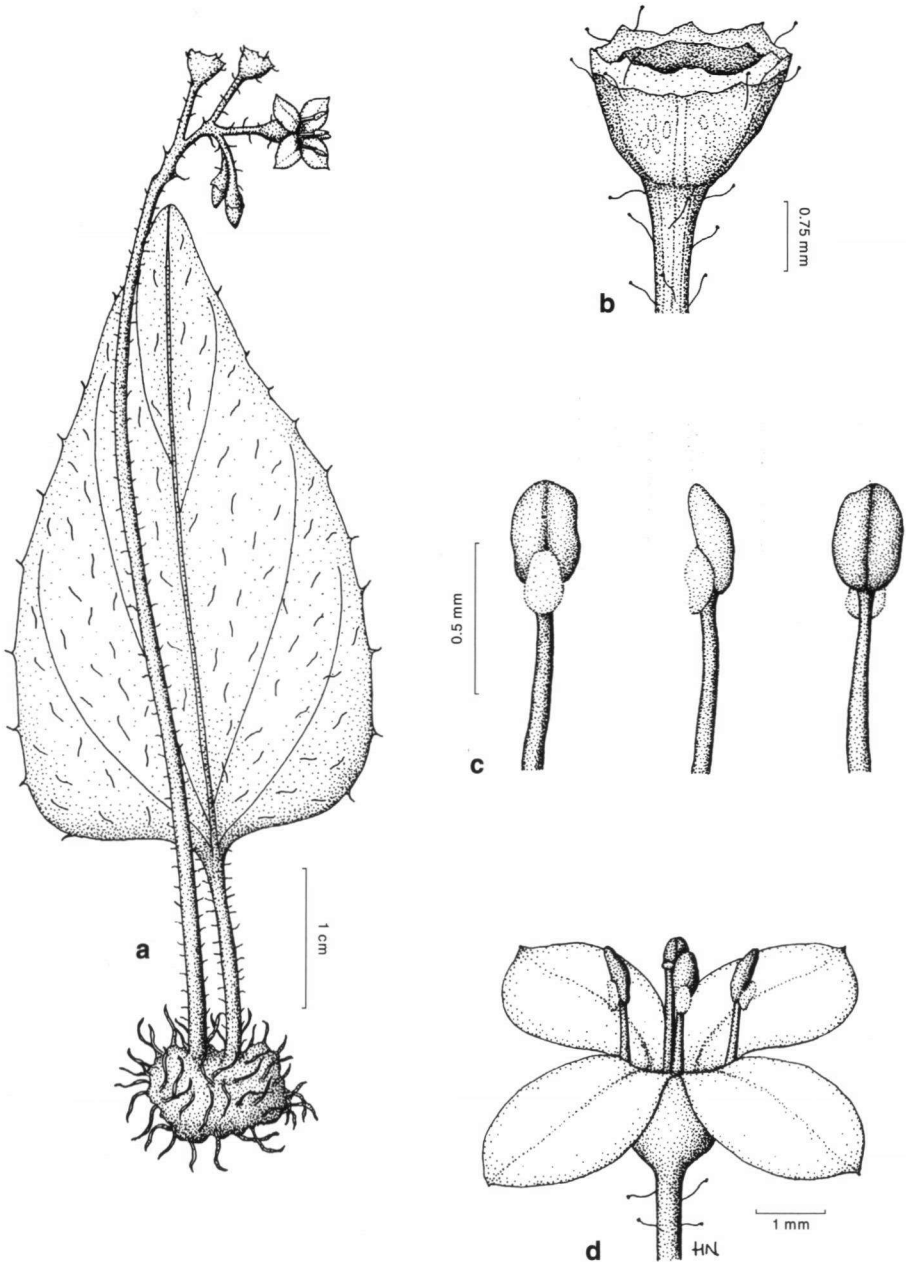


Fig. 6. *Phyllagathis tuberosa* (C. Hansen) Cellin. & S.S. Renner. a. Habit; b. capsule; c. dorsal lateral and ventral view of stamen; d. flower.

## ACKNOWLEDGEMENTS

This work is part of a doctoral dissertation submitted to the University of Reading, England. Financial support was partly provided by a fellowship from the European Union Human Capital and Mobility Programme: 'Botanical diversity in the Indo-Pacific Region'. Pieter Baas and Marco Roos coordinated the funds and I am very grateful for all their help and friendship. I am deeply grateful to Anton Weber (WU) who, at the beginning of my journey into the Sonerileae, generously handed me Hansen's unpublished material. Chris Humphries, Walter Judd and Susanne Renner provided invaluable intellectual support and guidance throughout the years. I thank the staff at the University of Mainz, the University of Florida and the Natural History Museum in London for their kind assistance with loans and various practical matters. Many thanks to Saw Leng Guan and the staff at KEP for logistic support and field assistance. I thank all the curators of the herbaria listed for providing loans and assisting with visits. The plates were beautifully drawn by Holly Nixon (TCD). I am grateful to John Beaman and Reed Beaman for constructive comments on the manuscript. Additionally, Reed Beaman provided invaluable help with producing the distribution maps.

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