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TAXONOMIC REVISION OF MAGNOLIA SECTION MAINGOLA (MAGNOLIACEAE)

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SUMMARY

Magnolia section *Maingola* Dandy is distinguished from other members of Magnoliaceae by the combination of a terminal brachyblast, cylindrical fruits, and free stipules. Morphological characters were re-examined for section *Maingola* and section *Alcimandra,* which has been considered to be closely related to the former. Although section *Alcimandra* is separated from section *Maingola* in having long stamens which hide the gynoecium, it is combined with section *Maingola* because this feature is frequently found in various other taxa of the family. Moreover, recent molecular phylogenetic studies have also demonstrated the close affinity between sections *Maingola* and *Alcimandra.* For the *Magnolia macklottii* complex, which has been problematic due to the wide range of variation in taxonomically important characters, a principal component analysis was carried out for 28 characters. Two varieties, *M. macklottii* var. *macklottii* and var. *beccariana*, are recognised in the complex. They are distinguished from each other mainly by hairs on fruit and peduncle (glabrous (to glabrescent)/densely hairy). Hairs on the twig, the length of scars of perianth and stamens, and leaf shape, which were previously regarded as important characters, could not separate the two varieties. In this study, seven species with five varieties are recognised in section *Maingola.*

Key words: *Magnolia*, Magnoliaceae, *Magnolia macklottii* complex, section *Maingola*, PCA.

INTRODUCTION

Section *Maingola* Dandy of genus *Magnolia* L. is distributed in tropical Southeast Asia from India (Assam) to Indochina and in Malesia extending to Sulawesi. It is distinguished from other sections in the genus *Magnolia* by the combination of terminal flowers, cylindrical fruits, and free stipules. Although some regional studies have been published for section *Maingola* (Nooteboom, 1987; Raju, 1993), there have been no comprehensive studies on section *Maingola* as a whole. Section *Alcimandra* Noot. shares an array of the same morphological features with section *Maingola* (Nooteboom, 1985). However, it has been distinguished from section *Maingola* by long stamens hiding the gynoecium. *Magnolia cathcartii* (Hook.f. & Thomson) Noot., the only member of section *Alcimandra*, was originally referred to *Michelia* (Hooker & Thomson, 1855) on account of the stipitate gynoecium and characters of the fruits. Later, Dandy (1927) separated *Alcimandra* as an independent genus from *Michelia.* The separation

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of these two groups could establish *Michelia* as a well-defined group with axillary flowers. After Dandy's treatment, its taxonomic position has been treated differently by later authors (Law, 1984, 1996; Nooteboom, 1985; Chen & Nooteboom, 1993).

The *Magnolia macklottii* complex, a group of closely related taxa in section *Maingola,* is also taxonomically problematic. Many closely related taxa such as *Manglietia macklottii* Korth. (= *Magnolia macklottii* (Korth.) Dandy), *Magnolia maingayi* King, *Magnolia javanica* Koord. & Valeton, *Michelia beccariana* A. Agostini (= *Magnolia beccariana* (A. Agostini) Noot.), *Magnolia aequinoctialis* Dandy, and *Magnolia uvariifolia* Dandy ex Noot. were recognised. The *Magnolia macklottii* complex exhibits a wide range of variation in morphological features, and its elements have never been comprehensively examined for their taxonomic dispositions and delimitations. In spite of the extensive variation in morphology, they are well distinguished from *M. carsonii* Dandy ex Noot., which is closely related to the complex, by relatively large leaves (> 12 cm) and the longer length (> 5 mm) of scars of perianth and stamens in fruit. In the revision of Malesian species, Nooteboom (1987) recognised *M. maingayi* and two varieties of *M. macklottii*, and newly described *M. uvariifolia.* Although hair conditions in twig and fruit, the length of scars of perianth and stamens, and the length of brachyblast were used to identify Malesian species of section *Maingola* (Nooteboom, 1987), their taxonomic significance needed further examination because the character states are often ambiguous and the range of variation is overlapping in some instances.

In this study, a taxonomic revision of section *Maingola* was carried out by the comprehensive examination of morphological characters. Especially the *M. macklottii* complex, of which elements were taxonomically confusing, was re-examined by principal component analysis (PCA) to clarify the taxonomic structure.

MATERIALS AND METHODS

Three hundred fifty-four specimens loaned from major and regional herbaria including Arnold Arboretum (A), the Natural History Museum, London (BM), Herbarium Bogoriense (BO), Royal Botanic Gardens, Edinburgh (E), Royal Botanic Gardens, Kew (K), Forest Research Institute of Malaysia (KEP), the National Herbarium Leiden, The Netherlands (L), and Missouri Botanical Garden (MO) were used in this study.

For the principal component analysis of the *M. macklottii* complex, 51 specimens with mature fruit were examined. Twenty-eight characters representing morphological variable features of the *M. macklottii* complex were analyzed (Table 1, Fig. 1). Among morphological characters, the length of terminal buds and types of pubescence (pubescent or pilose vs. woolly), which were used as key characters in a previous treatment (Nooteboom, 1987), were excluded for principal component analysis because these characters show considerable variation during growth stages and even in the same specimen. The extent of hairiness was measured by four steps from glabrous (0) to densely hairy (3).

Numerical Taxonomy and Multivariate Analysis System (NTSYS, version 1.7; Rohlf, 1992) was used for PCA. The standardisation of raw data matrix was performed using STAND command. A similarity matrix was generated using SIMINT command with CORR option, and canonical vectors are generated using CVA and PROJ commands. For the three-dimensional scatter plotting, SAS/GRAPH (version 6.03; SAS Institute Inc., 1988) program was used.

Table 1. Morphological characters of the *Magnolia macklottii* complex examined for the principal component analysis. See Fig. 2 for further clarification.

Character number	Description [unit]
C1	Leaf length [mm]
C2	Length of acumen [mm]
C3	C1–C2
C4	C2/C3
C5	Leaf width [mm]
C6	Leaf apex to the position of maximum width–length of leaf apex
C7	C3/C5
C8	C3/C6
C9	Length of petiole [mm]
C10	Diameter of middle position of petiole [mm]
C11	C3/C9
C12	Number of pairs of lateral nerves [number]
C13	Angle of leaf apex [°]
C14	Angle of leaf base [°]
C15	Thickness of middle position of leaf [mm]
C16	Diameter of fruiting twig (middle position of the second internode) [mm]
C17	Length of peduncle [mm]
C18	Diameter of peduncle (middle position) [mm]
C19	Number of carpels [number]
C20	Length of gynophore [mm]
C21	Length of scar of perianth & stamen [mm]
C22	Length of pedicle [mm]
C23	C17/C20
C24	Density of hairs in bud [0–3]*
C25	Density of hairs in twig [0–3]*
C26	Density of hairs in leaf nerve (2/3 position from the apex) [0–3]*
C27	Density of hairs in peduncle [0–3]*
C28	Density of hairs on fruit [0–3]*

*) Measured by four steps: glabrous (0) – densely hairy (3).

MORPHOLOGY

Twig

Generally, the diameter of twigs is very variable in section *Maingola*. *Magnolia annamensis* and *M. griffithii* have relatively thicker twigs (> 4 mm) than other taxa. Bud (or brachyblast) length is also highly variable even in the same taxa. In a previous study of Malesian *Maingola* (Nooteboom, 1987), the length of the brachyblast was used as an important character to distinguish *M. maingayi* from *M. uvariifolia*. However, this character varies depending on the stage of growth. If the maximum length of brachyblast is measured just before opening, it will be equal with the length of the stipule. It is almost impossible to compare the length of the stipules because they fall immediately as the bud opens and shrink soon, and only few herbarium sheets retain stipules. Therefore, this character was excluded from the principal component analysis in this study.

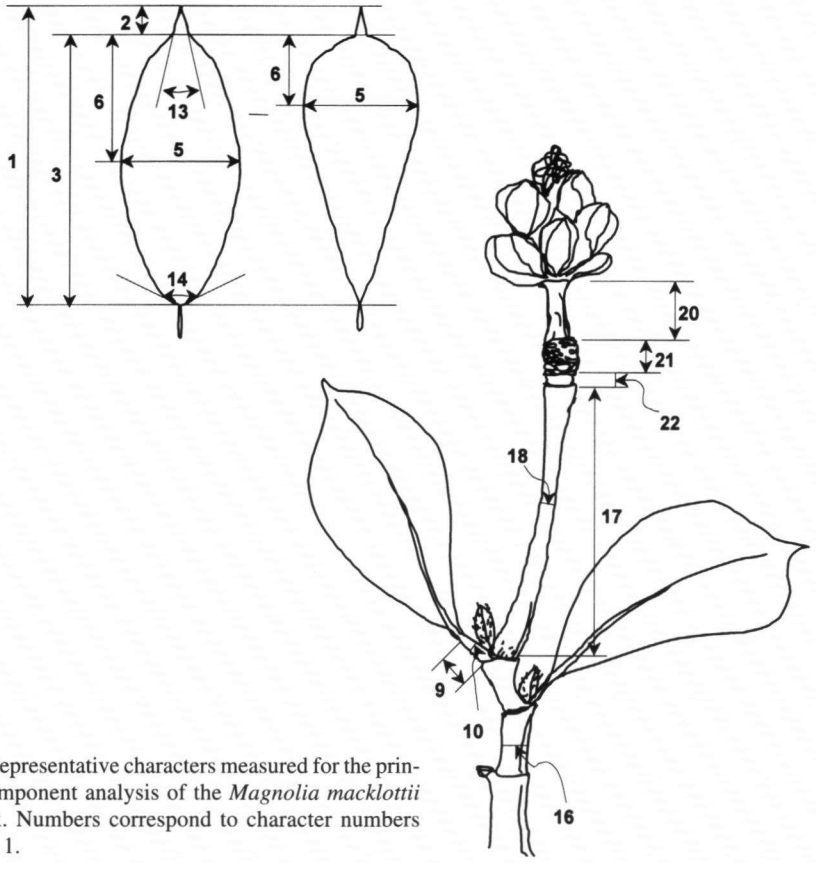


Fig. 1. Representative characters measured for the principal component analysis of the *Magnolia macklottii* complex. Numbers correspond to character numbers in Table 1.

Hair condition on the twig was also used as a key character to distinguish *M. maingayi* and *M. uvariifolia* from other taxa of Malesian species of section *Maingola* (Nooteboom, 1987). Even though it was claimed that *M. maingayi* and *M. uvariifolia* with woolly (long entangled) hairs on the twigs were distinguished from *M. macklottii* with pubescent, pilose, or glabrous twigs, it is very difficult to discriminate woolly hairs from the others. Moreover, the woolliness of hairs in the *M. macklottii* complex shows a wide range of variation in specimens of the same locality, and even in the same specimen. On the other hand, twigs of three varieties of *M. carsonii* and *M. gustavii* are entirely glabrous.

Leaf

Petioles in section *Maingola* are free from the stipules. Leaves of *M. annamensis, M. griffithii, M. pealiana*, and some specimens of the *M. macklottii* complex are relatively large (> 20 cm). Leaf shapes of the *M. macklottii* complex are highly variable. In general, the leaves of *M. macklottii* var. *beccariana* are widest around the mid-portion of leaves in comparison to *M. macklottii* var. *macklottii*, which indicates that leaves of *M. macklottii* var. *beccariana* are usually elliptic to slightly obovate while

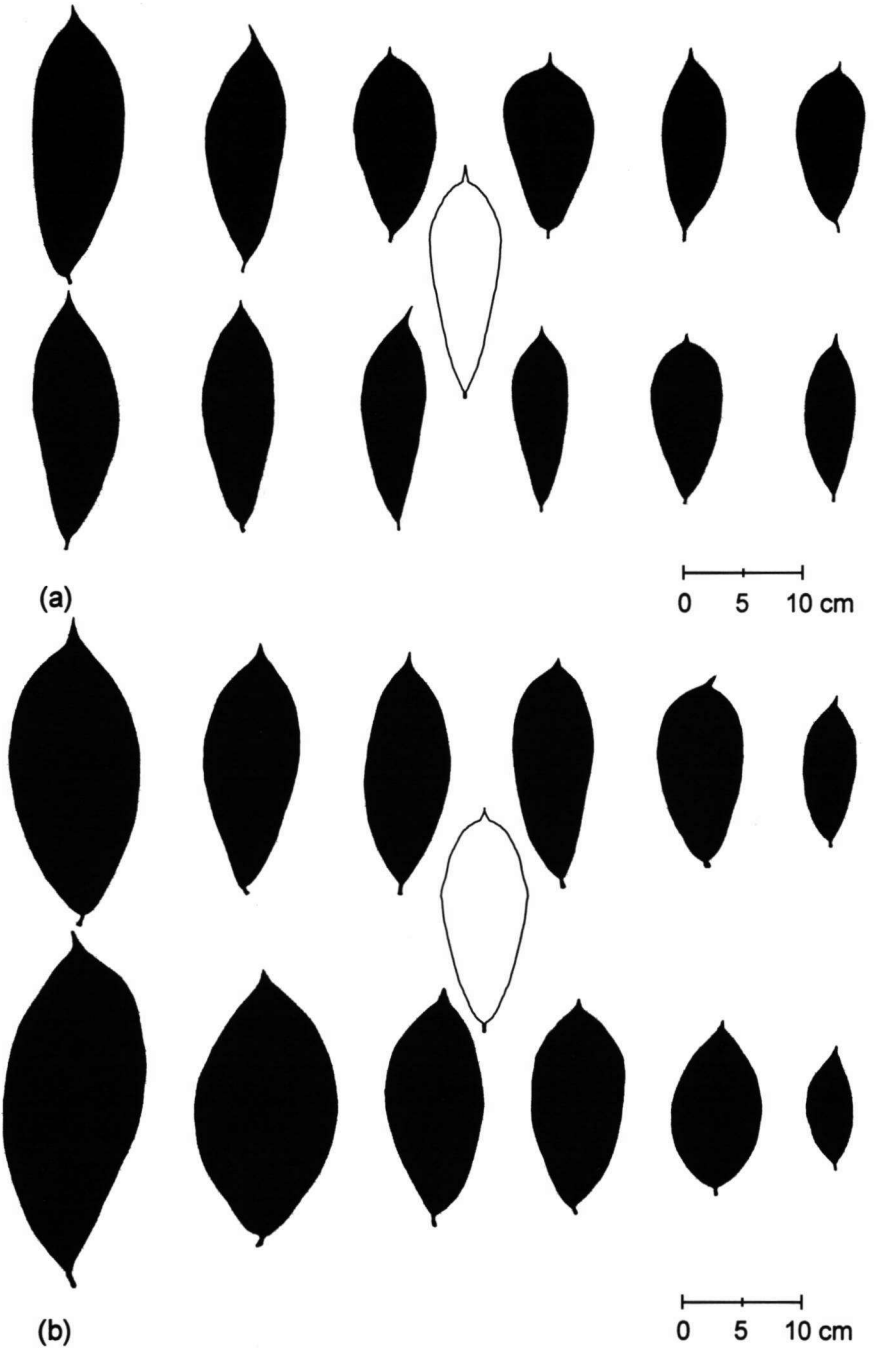
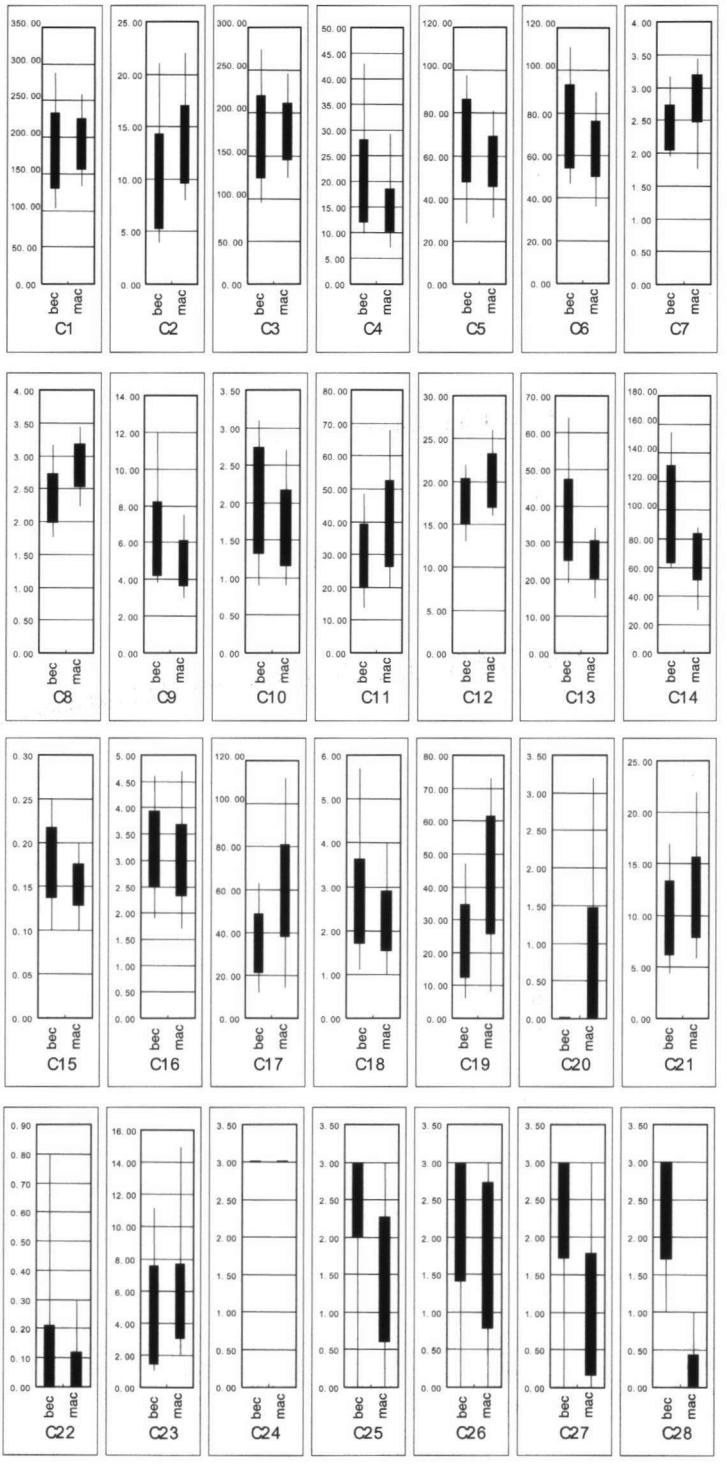


Fig. 2. Variation of leaf shape in the *Magnolia macklottii* complex. a. *Magnolia macklottii* var. *macklottii*; b. *M. macklottii* var. *beccariana*. Outlined leaves were reconstructed with the mean values of the variables measured for PCA analysis.


C1
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the leaves of *M. macklottii* var. *macklottii* are obovate to narrowly obovate (Fig. 2). However, these two varieties could not be separated from each other solely by the shape of leaves (C7 and C8, Fig. 3).

The leaf shape of *M. cathcartii* is very similar to that of *M. gustavii*, as Dandy (1927) mentioned when he first established the genus *Alcimandra*. It is very difficult to discriminate them without flowers.

The leaf apex of *M. carsonii* var. *drymifolia* is considerably variable, from acuminate or blunt to sometimes emarginate. However, some characters such as thickness of leaf and length of scars of stamen and tepals are constant in *M. carsonii* var. *drymifolia*. The other two varieties of *M. carsonii*, *M. carsonii* var. *carsonii* and *M. carsonii* var. *phaulanta*, and other taxa in section *Maingola* have leaves with more constant shape of the leaf apex.

The angle of the leaf base of *M. macklottii* var. *beccariana* is larger than that of *M. macklottii* var. *macklottii* in general (Fig. 2). *Magnolia macklottii* var. *macklottii* has a narrowly cuneate base and *M. macklottii* var. *beccariana* has, in most cases, a cuneate or round base. However, this character is not constant in the two varieties just like their leaf shape.

Coriaceous leaves is a reliable character for *M. annamensis* and *M. carsonii*. Also, this qualitative feature could be measured quantitatively. Leaves thicker than 0.25 mm are regarded as coriaceous when dried (in the herbarium sheets). A thick coriaceous state is observed in *M. annamensis* and *M. carsonii* var. *drymifolia*, where the leaves are thicker than 0.3 mm when dried.

Magnolia griffithii has white papillae in the lower surface of the leaf which could be seen under a dissecting microscope (Fig. 4). All other taxa in section *Maingola* do not have this type of papillae. Morphological features including leaf size and shape are very similar in *M. griffithii* and *M. pealiana*. Although Raju (1993) combined them as a single species, white papillae served as a very useful character to distinguish them.

Flower

Section *Maingola* has bisexual, terminal flowers and introrsely dehiscent anthers. Previously, *M. cathcartii* has been treated as a separate section *Alcimandra* because they have long stamens hiding the gynoecium (Nooteboom, 1985). The taxonomic status of *Alcimandra* as an independent section is not supported because long stamens hiding the gynoecium, which is the only character to separate section *Alcimandra* from section *Maingola*, are also found in species of *Pachylarnax* (*P. praecalva*; Nooteboom, 1985), *Michelia* (*Mich. xanthantha*, *Tsoongiodendron odorum* (= *Mich. odora*); Law, 1996), and *Elmerrillia* (*E. tsciampacca* subsp. *tsiampacca* var. *tsiampacca*; Nooteboom, 1985). Furthermore, all members of sections *Maingola* and *Alcimandra* were included in the same clade according to the phylogenetic analyses of chloroplast DNA genes (Kim, 2001; Kim et al., 2001). Therefore, sections *Maingola* and *Alcimandra* are combined as a section *Maingola*. Although the length of the stamens is almost the same as the length of the gynoecium in *M. carsonii* var. *drymifolia*, it is easily dis-

Fig. 3. Ranges and standard deviations for characters of two varieties of *M. macklottii* used in principal component analysis (C1–C28). Solid bar indicates standard deviation. Character numbers correspond to Table 1. bec = *M. macklottii* var. *beccariana*; mac = *M. macklottii* var. *macklottii*.

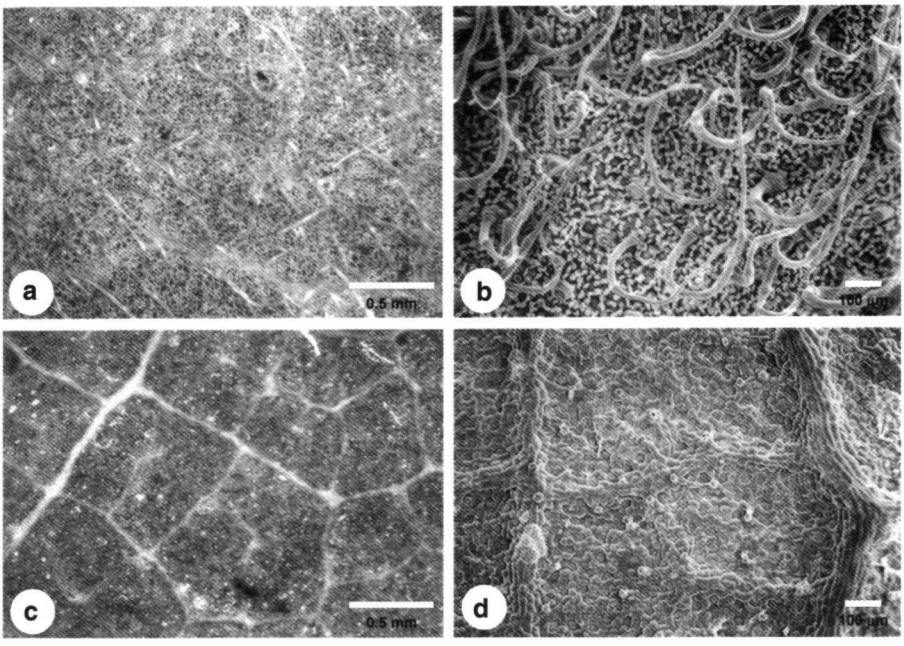


Fig. 4. Comparison of the lower surface of leaf. a & b. *Magnolia griffithii* (*Parkinson 397*). White papillae are present; c & d. *M. pealiana* (*Mann s.n.*). White papillae are absent. a and c are × 63 under dissecting microscope. b and d are × 100 under scanning electron microscope.

tinguished from *M. cathcartii* by the size of flower. Another unique character of *M. cathcartii* in the section *Maingola,* round-tipped appendage of the connectives, was observed in this study. Other members in the section *Maingola* have a short acute appendage, or rarely no appendage.

Fruit

Fruits of section *Maingola* are cylindric and each carpel dehisces dorsally. The presence of a gynophore is not constant in the section *Maingola. Magnolia cathcartii, M. gustavii,* and *M. griffithii* have a considerably long gynophore, but others do not have this, or only a very short one. In the two varieties of *M. macklottii*, only a few specimens of *M. macklottii* var. *macklottii* have a very short (< 2 mm) gynophore, and it is not a key character to distinguish the two varieties. This character seems to have evolved parallel during the evolutionary process of the family Magnoliaceae as indicated in the molecular study (Kim, 2001; Kim et al., 2001).

Pedicle is not a pedicel, but the internode in the Magnoliaceae, if present, between the uppermost bract and the perianth (Nooteboom, 1993). A pedicle is also present or absent in the section. Relatively small sized fruits with a few numbers of carpels are found in *M. carsonii.* Length of the scars of stamens and tepals is a reliable character for distinguishing *M. carsonii* (< 4 mm) from the other taxa (6–20 mm) in the section. This character is relatively constant throughout the growth. The hairs on peduncle

Table 2. Loading values of the first three principal components for 28 morphological characters from the analysis of 51 individuals of the *Magnolia macklottii* complex.

Character number	PC1	PC2	PC3
C1	−0.745*	−0.598	−0.012
C2	−0.573	−0.461	0.265
C3	−0.760*	−0.445	−0.138
C4	0.106	0.554	−0.178
C5	0.214	0.545	−0.356
C6	−0.070	0.537	0.142
C7	−0.925*	−0.109	0.260
C8	−0.955*	−0.113	0.105
C9	−0.665*	0.367	0.102
C10	−0.953*	0.124	−0.134
C11	−0.162	−0.494	0.144
C12	−0.214	−0.528	0.095
C13	0.580	0.591	0.275
C14	0.548	0.659*	−0.061
C15	−0.983*	0.053	0.023
C16	−0.952*	0.094	−0.060
C17	0.573	−0.550	0.323
C18	−0.931*	0.103	−0.215
C19	0.412	−0.665*	−0.412
C20	−0.936*	−0.024	0.168
C21	−0.310	−0.431	−0.658*
C22	−0.981*	0.046	0.004
C23	−0.003	0.009	0.951*
C24	−0.961*	0.053	0.212
C25	−0.848*	0.321	0.045
C26	−0.874*	0.145	−0.218
C27	−0.795*	0.409	−0.062
C28	−0.766*	0.570	−0.070
Eigenvalue	14.143	4.715	2.277
Cumulative % of variance	50.51%	67.35%	75.49%

*) Characters significantly loaded to principal components.

and carpel are also variable as hairs on twig. The extant of hairiness (glabrous (to glabrescent)/densely hairy) in peduncle and fruit is an important character for subgrouping in the *M. macklottii* complex.

PRINCIPAL COMPONENT ANALYSIS OF MAGNOLIA MACKLOTTII COMPLEX

The first three principal components showed 50.51%, 16.84%, and 12.14% of the total variance, respectively. Cumulative value of variance of the first three principal components was 79.49% (Table 2). In the first principal component, important characters, of which loading values were over 0.6, were leaf length (C1, C3), the characters related to leaf shape (C7, C8), length and diameter of petiole (C9, C10), thickness of leaf (C15), diameter of twig and peduncle (C16, C18), length of gynophore and pedicle

(C20, C22), and characters related to hairs (C24–C28). Angle of leaf base (C14) and the number of carpels (C19) were highly loaded to the second principal component, and length of scar of perianth and stamens (C21) and relative length of gynophore to peduncle (C23) were highly loaded to the third principal component. In the three-dimensional diagram using the first three principal components (Fig. 5), two groups of OTUs were recognised and these were divided mainly by the first principal component axis (PC1). We recognise all members of the complex as a species, which is *M. macklottii,* rather than several species as recognised by a previous author (Nooteboom, 1987) because the three-dimensional diagram of PCA show relatively loose grouping and the range of character states of most characters are overlapping (C1–C26, Fig. 4) in the size diagram except the characters of hairs in peduncle and fruit (C27 and C28, Fig. 3). The OTUs of two groups are the specimens identified as *M. macklottii* var. *macklottii* and *M. uvariifolia,* and *M. macklottii* var. *beccariana* and *M. maingayi,* respectively, by previous authors (Nooteboom, 1987). On the basis of the PCA result, *M. uvariifolia* and *M. maingayi* are combined with each of the two varieties of *M. macklottii*, respectively. Two varieties of *M. macklottii*, var. *macklottii* and var. *beccariana*, are recognised in the complex mainly by hairs in fruit and peduncle (glabrous (to glabrescent)/densely hairy). Range of hairs in twig (C25, Fig. 3), leaf shape (C7 and C8, Fig. 3), and the length of scars of perianth and stamens (C21, Fig. 3), which are important characters for distinguishing two varieties of *M. macklottii, M. maingayi* and *M. uvariifolia* by a previous author (Nooteboom, 1987), are overlapping between two groups (C7, C8, and C25, Fig. 3). Although these characters are of no use to distinguish two varieties, the range diagram shows that *M. macklottii* var. *macklottii* has mainly obovate leaves and sparse hairs on the twigs and *M. macklottii* var. *beccariana* has mainly elliptic leaves and dense hairs on the twigs. The length of scars of perianth and stamens is highly overlapping.

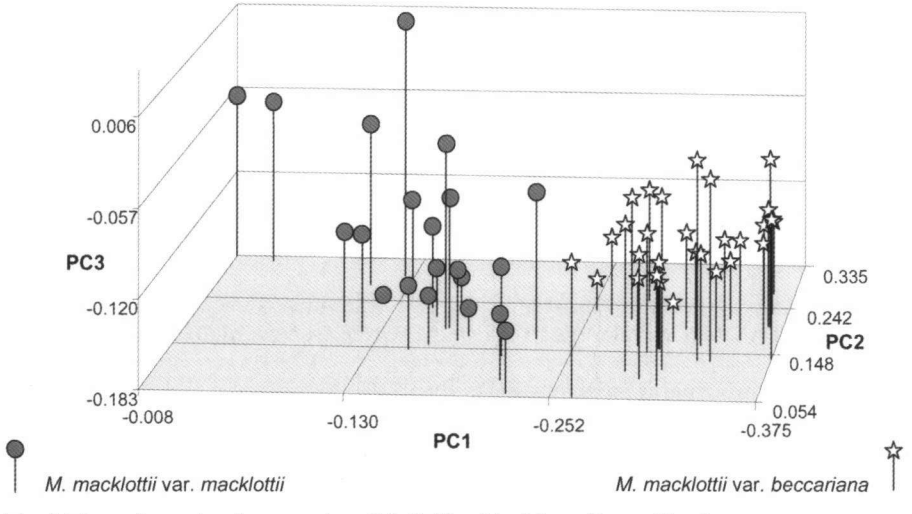


Fig. 5. Three-dimensional scatter plot of 51 OTUs of the *Magnolia macklottii* complex by principal components 1, 2, and 3.

TAXONOMIC TREATMENT

MAGNOLIA section MAINGOLA

Magnolia section *Maingola* Dandy (1948) sub t. 16; Dandy (1950) 71. — Type species: *Magnolia maingayi* King.

Alcimandra Dandy (1927) 260. — *Magnolia* sect. *Alcimandra* Noot. (1985) 88. — Type species: *Michelia cathcartii* Hook.f. & Thomson.

Trees evergreen. *Twigs* glabrous or hairy. *Leaves* glabrous or hairy; stipules free from petiole; prefoliation conduplicate, blade (narrowly) elliptic, oblong, or (narrowly) obovate; base cuneate to rounded, apex obtuse, mucronate, acuminate or rarely emarginate, lower surface rarely with white papillae. *Flowers* solitary; bisexual; anthers introrse; connective with short acute or round (rarely no) appendage; gynoecium partially exposed above stamens or embedded within the long stamens. *Follicetums* cylindric, glabrous or hairy; pedicles present or absent; carpels basally connate or rarely connate in developing fruit then separating and becoming free at dehiscence, without beaks; seeds 2 per carpel.

Distribution — Species 7: India (Assam, Sikkim), Bhutan, Burma, Vietnam, China (southern & south-eastern Xizang), Thailand, Malaysia, Brunei, and Indonesia.

KEY TO THE SPECIES

1a. Leaves with 12–16 lateral nerve pairs. Stamens > 3 cm, connective with a round-tipped appendage. Gynoecium embedded within the long stamens ..... **3. M. cathcartii**

b. Leaves with 8–28 lateral nerve pairs. Stamens < 1.5 cm, connective with an acute (rarely obtuse) appendage. Gynoecium partially exposed above the stamens . 2

2a. Leaves 5–12 cm long with 8–15 lateral nerve pairs. Cluster of perianth and stamen scars 1–4 mm long ..... **2. M. carsonii**

b. Leaves 12–34 cm long with 13–28 lateral nerve pairs. Cluster of perianth and stamen scars 6–20 mm long 3

3a. Leaves coriaceous with 17–21 lateral nerve pairs; petiole 4–5 mm diam., dilated at base ..... **1. M. annamensis**

b. Leaves membranous with 13–28 lateral nerve pairs; petiole 1–4.5 mm diam., dilated at base or not 4

4a. Twigs entirely glabrous. Leaves with 15–17 lateral nerve pairs. Fruits with connate carpels in developing fruits, separating and becoming free at dehiscence ..... **5. M. gustavii**

b. Twigs glabrous or hairy. Leaves with 13–28 lateral nerve pairs. Fruits with basally connate carpels in developing fruits, separating and becoming free at dehiscence 5

5a. Leaves with 13–26 lateral nerve pairs. Petiole not dilated at base. Gynophore absent or 3 mm long when present ..... **6. M. macklottii**

b. Leaves with 23–28 lateral nerve pairs. Petiole dilated at base. Gynophore 10 mm 6

6a. Lower surface of leaf with white papillae ..... **4. M. griffithii**

b. Lower surface of leaf lacking papillae ..... **7. M. pealiana**

1. Magnolia annamensis Dandy

Magnolia annamensis Dandy (1930) 209. — Type: *Chevalier 38877* (holo P; iso L, MO, NY), Vietnam, Annam, Nhatrang.

Twigs densely woolly, c. 5 mm diam.; buds woolly pubescent, 1–3 cm long, 6–7 mm diam. *Leaves* pubescent only at the base of midrib; petiole 0.8–1.5 cm long, 4–5 mm diam., dilated at base; blade elliptic, 22–27 by 10–13 cm, thick coriaceous, 0.3–0.35 mm thick when dried, base obtuse to rounded, apex mucronate, acumen c. 10 mm long, lateral nerve pairs 17–21; lower surfaces lacking papillae. *Flowers*: gynoecium partly exposed above stamens. *Follicetums* cylindric; gynophore absent; carpels c. 13, basally connate in developing fruit then separating and becoming free at dehiscence, tawny pubescent.

Distribution — Vietnam (Annam).

Note — Due to the paucity of specimens of *M. annamensis*, only three sheets (all types) were available for this study. Since Dandy first described *M. annamensis* in 1930, Gagnepain (1938) included *M. annamensis* var. *affinis* in his French paper regarding Vietnamese magnolias. In this paper, he did not provide any information on the reference of the original description, and we also failed to locate any previous publications of Gagnepain with the original description of *M. annamensis* var. *affinis*. If he tried to describe newly the variety in his paper of 1938, the name cannot be taken to be legitimate because the Latin description was not provided. *Magnolia annamensis* var. *affinis* is excluded in this study because the original source of the variety description is uncertain yet.

2. Magnolia carsonii Dandy ex Noot.

Magnolia carsonii Dandy ex Noot. (1987) 138. — Type: *SAN A 1680* (holo L; iso K, KEP, L, SING), Malaysia, Sabah, Ranau, Tenompok.

Carson's Magnolia Meijer (1968) 7, fig. — *Magnolia 'carsonii'* Dandy ex Cockburn (1980) 56, t. 17, nom. nud.

Trees up to 40 m tall, 30–90 cm diam. *Twigs* glabrous, 1–4 mm diam.; buds glabrous or tomentose, 0.9–2.5 cm long, 2–4 mm diam. *Leaves* glabrous; petiole 0.8–1.5 cm long, 1–2 mm diam., not dilated at base; blade narrowly elliptic to narrowly obovate, 5–12 by 2.5–6 cm, coriaceous or membranous, 0.2–0.3 mm thick when dried, base cuneate to rounded, apex acuminate, mucronate or rarely emarginate, acumen 0.3–1.2 cm long, lateral nerve pairs 8–15, lower surface lacking papillae. *Flowers* 3–5 cm diam.; outer tepals 3, spatulate to oblong, 1.8–2.5 by 0.3–0.8 cm; inner tepals 6, oblong, 1.8–2.5 by 0.3–0.8 cm; stamens 6–8 mm long, connective with a 0.5–1 mm long acute appendage, filaments 0.5–1 mm long; gynoecium 5–8 mm long, partly exposed above stamens. *Follicetums* cylindric, 1–5 by 1.5–2.5 cm, glabrous; carpels 3–17, basally connate in developing fruit then separating and becoming free at dehiscence; gynophore 0–3 mm long; peduncles glabrous or rarely hairy, 1.9–4.5 cm long, 0.8–2.5 mm diam.; pedicles 0–1 mm long; cluster of perianth and stamen scars 1–4 mm long.

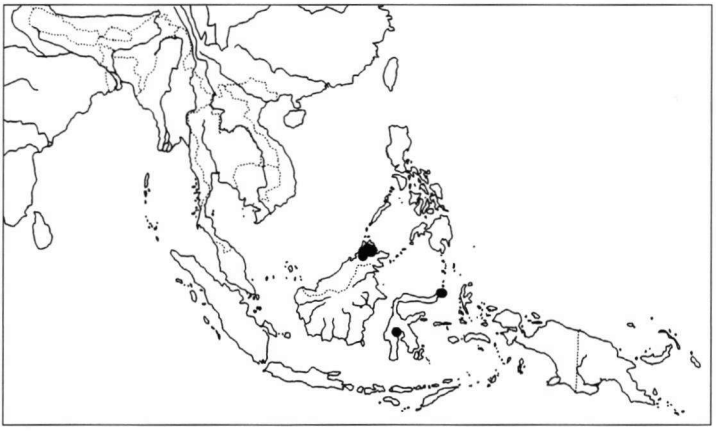
KEY TO THE VARIETIES

1a. Leaves thick coriaceous, c. 0.3 mm thick when dried, apex obtuse, mucronate, or rarely emarginate. Buds tomentose or rarely glabrous ..... **b.** var. **drymifolia**
b. Leaves thin coriaceous or membranous, less than 0.2 mm thick when dried, apex acuminate or mucronate. Buds glabrous 2
2a. Cluster of perianth and stamen scars c. 1 mm long. Leaf blade 5–7 cm long .. .. **c.** var. **phaulanta**
b. Cluster of perianth and stamen scars 2–3 mm long. Leaf blade 8–12 cm long . ..... **a.** var. **carsonii**

a. var. **carsonii** — Map 1

Twigs 2–3 mm diam., buds glabrous, c. 2.5 cm long, c. 2 mm diam. *Leaves*: petiole 0.8–1.2 cm long, 1–1.5 mm diam.; blade elliptic to obovate, 8–12 by 3–5 cm, thin coriaceous, c. 0.2 mm thick when dried, base cuneate, apex acuminate, acumen 0.4–1.2 cm long, lateral nerve pairs 12–15. *Flowers* 4–5 cm diam.; outer tepals spatulate, c. 2.5 by 0.6 cm; inner tepals oblong, c. 2.5 by 0.7 cm; stamens c. 8 mm long, connective with c. 1 mm long acute appendage, filaments c. 0.5 mm long; gynoecium c. 7 mm long. *Follicetums*: carpels 13–17, without lenticels or only few small lenticels when mature; gynophore 0–2 mm long; peduncles glabrous, 3–4.5 cm long, 1–1.5 mm diam.; pedicles absent; cluster of perianth and stamen scars 2–4 mm long.

Distribution — Indonesia (Sulawesi) and Malaysia (Sabah).

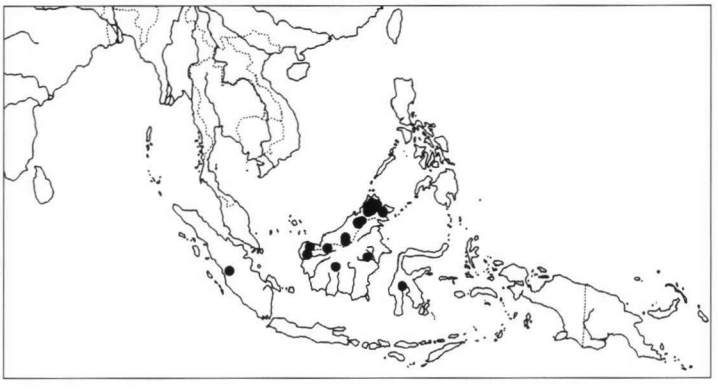


Map 1. Distribution of *Magnolia carsonii* Dandy ex Noot. var. *carsonii*.

b. var. **drymifolia** Noot. — Map 2

Magnolia carsonii var. *drymifolia* Noot. (1987) 351. — Type: *Nooteboom 4612* (holo L; iso BO), Indonesia, Central Kalimantan, Bukit Raya, 112°42' E, 0°39' S.

Drymis-leaved Magnolia Meijer (1968) 8, fig. — *Magnolia 'drymifolia'* Dandy ex Cockburn (1980) 55, nom. nud.



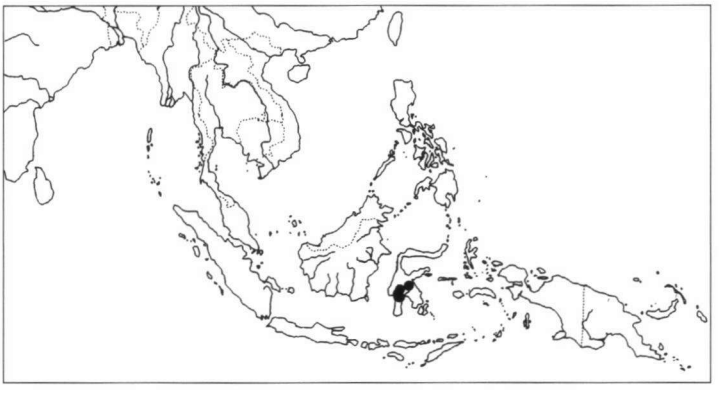
Map 2. Distribution of *Magnolia carsonii* Dandy ex Noot. var. *drymifolia* Noot.

Twigs 2–4 mm diam.; buds tomentose or rarely glabrous, 0.9–2.2 cm long, 3.5–4.5 mm diam. *Leaves*: petiole 0.8–1.5 cm long, 1–2 mm diam.; blade narrowly elliptic to narrowly obovate, 7–12 by 3–6 cm, thick coriaceous, c. 0.3 mm thick when dried, base broadly cuneate to rounded, apex obtuse, mucronate, or rarely emarginate, acumen 3–7 mm long, lateral nerve pairs 8–13. *Flowers* c. 4 cm diam.; outer tepals oblong, c. 1.8 by 0.8 cm; inner tepals oblong, c. 2 by 0.8 cm; stamens c. 8 mm long, connective with c. 1 mm long acute appendage, filaments 0.5–1 mm long; gynoecium c. 8 mm long. *Follicetums*: carpels 5–9, with lenticels when mature; gynophore 0–3 mm long; peduncles glabrous or rarely glabrescent, 1.9–4.5 cm long, 1.7–2.5 mm diam.; pedicles 0–1 mm long; cluster of perianth and stamen scars 3–4 mm long.

Distribution — Indonesia (Sulawesi, Kalimantan, Sumatra), and Malaysia (Sabah, Sarawak).

c. var. **phaulanta** (Dandy ex Noot.) S. Kim & Noot., *stat. nov.* — Map 3

Magnolia phaulanta Dandy ex Noot. (1987) 359. — Type: *FRI bb 29194* (holo L; iso A, K), Indonesia, Sulawesi, Rantelemo.



Map 3. Distribution of *Magnolia carsonii* Dandy ex Noot. var. *phaulanta* (Dandy ex Noot.) S. Kim & Noot.

Twigs 1–2 mm diam.; buds glabrous, c. 1.7 cm long, 2 mm diam. *Leaves*: petiole c. 5 mm long, 1–1.2 mm diam.; blade elliptic to narrowly elliptic, 5–7 by 2.5–3.5 cm, thin coriaceous to membranous, c. 0.2 mm thick when dried, base broadly cuneate, apex mucronate, acumen c. 5 mm long, lateral nerve pairs 8–11. *Flowers* c. 3 cm diam.; outer tepals spatulate, c. 1.8 by 0.3 cm; inner tepals slightly longer; stamens c. 6 mm long, connective with c. 0.5 mm long acute appendage; filaments c. 0.5 mm long. *Follicetums*: carpels 3–5; gynophore absent; peduncles glabrous, c. 2 cm long, 0.8 mm diam.; pedicles absent; cluster of perianth and stamen scars c. 1 mm long.

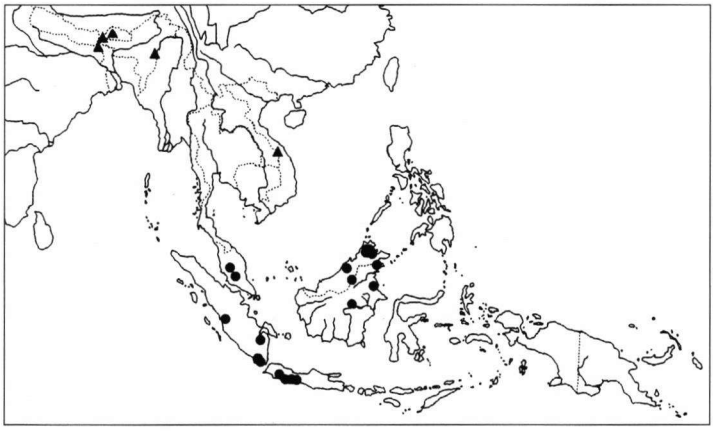
Distribution — Indonesia (Sulawesi).

3. **Magnolia cathcartii** (Hook.f. & Thomson) Noot. — Map 4

Magnolia cathcartii (Hook.f. & Thomson) Noot. (1985) 88. — *Michelia cathcartii* Hook.f. & Thomson (1855) 79; (1872) 42; King (1891) 214, t. 60. — *Alcimandra cathcartii* (Hook.f. & Thomson) Dandy (1927) 260. — Type: *Hooker s.n.* (holo K; iso K), India, Sikkim, Darjeeling.

Twigs pubescent or tomentose, c. 3 mm diam.; buds pubescent or tomentose, 0.8–3 cm long, 2–4 mm wide. *Leaves* hairy at least when young; petiole 0.7–1 cm long, 0.9–1.1 mm diam., not dilated at base; blade narrowly elliptic or narrowly ovate, 8–13 by 3.5–5 cm, membranous, c. 0.2 mm thick when dried, base broadly cuneate to rounded, apex acuminate, acumen 1–1.5 cm long; midrib in lower surface pubescent only at the base, lateral nerve pairs 12–16, lower surfaces lacking papillae. *Flowers* c. 8 cm diam.; outer tepals 3, spatulate, c. 4 by 0.8 mm; inner tepals 6, elliptic, c. 4 by 1.8 cm; stamens c. 3.2 cm long, connective with c. 2 mm long round-tapped appendage, filaments c. 7 mm long; gynoecium embedded within the long stamens. *Follicetums* cylindric, 8–10 by 2 cm, glabrous; carpels 20–30, basally connate in developing fruit then separating and becoming free at dehiscence; gynophore c. 15 mm long; peduncles glabrous, 3 cm long, 2.5 mm diam.; pedicles absent; cluster of perianth and stamen scars 6–8 mm long.

Distribution — Bhutan (Cukka), China (southern & south-eastern Xizang), India (Nagaland, Sikkim), and Vietnam (Annam).



Map 4. Distribution of *Magnolia cathcartii* (Hook.f. & Thomson) Noot. (▲) and *M. macklottii* (Korth.) Dandy var. *macklottii* (●).

Note — Even though a previous study on the Chinese Magnoliaceae (Chen & Nooteboom, 1993) reported this taxon distributed in southern and south-eastern Xizang province, this locality was not included in the present study because the distribution maps were solely based on the observed specimens available to us.

4. Magnolia griffithii Hook.f. & Thomson — Map 5

Magnolia griffithii Hook.f. & Thomson (1872) 41. — *Michelia griffithii* (Hook.f. & Thomson) Finet & Gagnep. (1905) 42. — Type: *Griffith s.n.* (holo CAL; iso K), India, Assam, near Sadya.

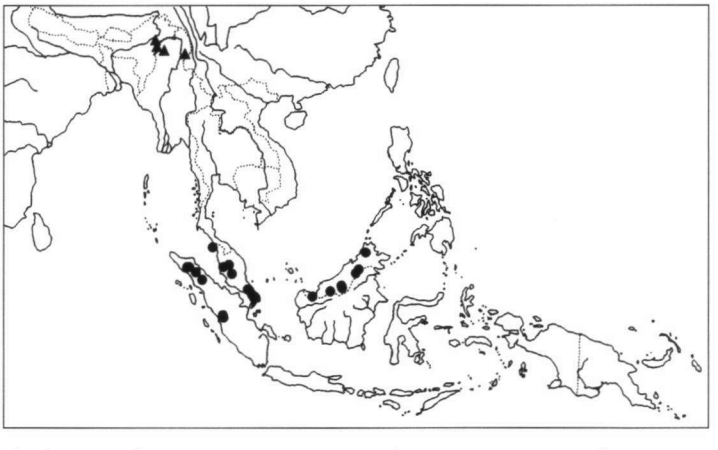
Twigs pubescent, 3.8–5.6 mm diam.; buds 7–10 cm long, 7–8 mm wide, covered with whitish, sericeous, appressed hairs. *Leaves* hairy at least when young; petiole 0.6–1.2 cm long, 3–4.5 mm diam., dilated at base; blade elliptic, 25–34 by 10–13 cm, membranous, 0.2–0.25 mm thick when dried, base cuneate, apex acuminate, acumen c. 2 cm long, lateral nerve pairs 23–28; lower surface with white papillae. *Flowers* c. 9 cm diam. when fully expanded; tepals 9; inner tepals smaller than outer tepals; gynoecium partly exposed above stamens. *Follicetums* cylindric, 13–17 by 2.5–3 cm, glabrous; carpels 50–78, basally connate in developing fruit then separating and becoming free at dehiscence; gynophore c. 12 mm long; peduncles pubescent, 60–85 mm long, 3.5–4.2 mm diam.; pedicles c. 1 mm long; cluster of perianth and stamen scars 8.5–11 mm long.

Distribution — Burma (Kachin, Sagaing) and India (Assam, Nagaland).

5. Magnolia gustavii King

Magnolia gustavii King (1891) 209. — Type: *Mann s.n.* (holo CAL; iso K, L sheet 908.126-1830), India, Assam, Makum forest.

Twigs glabrous, 1.8–2.4 mm diam.; buds rarely pubescent only at the apex, c. 8 mm long, 2 mm diam. *Leaves* glabrous; petiole 6–7.5 mm long, c. 1 mm diam., not dilated



Map 5. Distribution of *Magnolia griffithii* Hook.f. & Thomson (▲) and *M. macklottii* (Korth.) Dandy var. *beccariana* (A. Agostini) Noot. (●).

at base; blade narrowly elliptic, 13–16 by 3.5–4 cm, membranous, c. 0.2 mm thick when dried, base cuneate, apex acuminate or shortly acuminate, acumen c. 11 mm long, lateral nerve pairs 15–17, lower surfaces lacking papillae. *Flowers* c. 5 cm diam.; tepals obovate, c. 4 by 1 cm; stamens c. 1.2 cm long; connective with c. 2 mm long acute appendage; filaments c. 2 mm long; gynoecium c. 1.8 mm long, partly exposed above stamens. *Follicetums* cylindric, c. 10 by 3 cm, glabrous; carpels 25–35, connate in developing fruit then separating and becoming free at dehiscence, the length of the face that makes contact with the next carpel more than 3/4 of the carpel length; gynophore 0–4 mm; peduncles glabrous, 4–5 cm long, 2–3 mm diam.; pedicles absent; cluster of perianth and stamen scars c. 15 mm long.

Distribution — India (Assam) and Thailand (Petchaburi).

Note — Recently, a new collection was reported from Petchaburi province, 240 km south-west of Bangkok, Thailand (*P. Chalermglin 440216*).

6. **Magnolia macklottii** (Korth.) Dandy

Magnolia macklottii (Korth.) Dandy (1927) 263; Backer & Bakh.f. (1963) 97; Noot. (1986) 141. — *Manglietia macklottii* Korth. (1851) 97; Miq. (1858) 15, excl. coll. Haleban; Miq. (1860) 153; (1868) 71, excl. coll. ex Haleban. — Type: *Korthals s.n.* (holo L sheet 908.126-1018; iso BO sheet 1291543), Indonesia, Sumatra, Sungalang.

Magnolia javanica Koord. & Valeton (1896) 315; Koord. (1912) 239; Koord.-Schum. (1913) 2; Koord. & Valeton (1918) 4, t. 800; Rant (1929) 446. — *Magnolia pealiana* Koord. & Valeton (1896) 148, 314 (non King) (err. '*pealii*'). — Type: *Koorders 4520* (lecto L; isolecto BO), Indonesia, Java, NW Galoenggoeng.

Magnolia uvariifolia Dandy ex Noot. (1987) 358. — Type: *Clemens 28439* (holo L; iso A, K, NY), Malaysia, Sabah, Ranau, Tenompok.

Trees up to 25 m tall, 35–50 cm diam. *Twigs* pubescent, pilose, woolly, or rarely glabrous, 2–4.5 mm diam.; buds pubescent, woolly, or rarely glabrous, 1–1.5 cm long, 3–4 mm diam. *Leaves* hairy at least when young; petiole 3–12 mm long, 1–3 mm diam., not dilated at base; blade elliptic to narrowly elliptic or obovate to slightly obovate, 12–24 by 4–9 cm, membranous, 0.1–0.25 mm thick when dried, base cuneate to rounded, apex acuminate to shortly acuminate, acumen 5–22 mm long, midrib in lower surface pubescent or rarely glabrous, lateral nerve pairs 13–26, lower surfaces lacking papillae. *Flowers*: outer tepals 3, obovate, 2–4 by 1–2 cm; inner tepals 6, obovate, 2–3.3 by 0.9–1.3 cm; stamens 6–9 mm long; connective with c. 1 mm long acute appendage or not, filaments c. 1 mm long; gynoecium partly exposed above stamens. *Follicetums* cylindric, 4–14 by 2–3 cm, glabrous, pubescent, pilose, or woolly, glabrescent; carpels 10–70, basally connate in developing fruit then separating and becoming free at dehiscence; gynophore 0–2 mm long; peduncles glabrous, pubescent, pilose, or woolly, glabrescent, 4–8 cm long, 1.5–3 mm diam.; pedicles 0–1 mm long; cluster of perianth and stamen scars 1–2 cm long.

KEY TO THE VARIETIES

1a. Fruits and peduncles usually glabrous, if hairy glabrescent .. **a.** var. **macklottii**
b. Fruits and peduncles densely hairy ..... **b.** var. **beccariana**

a. var. **macklottii** — Map 4

Leaves: petiole 3–7 mm long, 1–2.5 mm diam.; blade obovate to narrowly obovate, 14–23 by 4–7 cm, 0.1–0.2 mm thick when dried; base narrowly cuneate, apex acuminate, acumen 7–22 mm, midrib in lower surface glabrous to glabrescent, lateral nerve pairs 16–26. *Flowers*: outer tepals 3, obovate, 3.5–4 by 1–2 cm; inner tepals 6, obovate, 2.5–3.3 by 0.9–1.3 cm; stamens 6–8 mm long, connective with c. 1 mm long acute appendage. *Follicetums* 6–14 by 2–3 cm, glabrous to rarely glabrescent; carpels 10–70; gynophore 0–2 mm; peduncles glabrous or rarely glabrescent, 4–8 cm long, 1.5–3 mm diam.; cluster of perianth and stamen scars 1–2 cm long.

Distribution — Indonesia (Java, Kalimantan, Sumatra), Malaysia (Malaya, Sabah, Sarawak), and Brunei.

b. var. **beccariana** (A. Agostini) Noot. — Map 5

Magnolia macklottii var. *beccariana* (A. Agostini) Noot. (1987) 348. — *Michelia beccariana* A. Agostini (1926) 184. — *Magnolia beccariana* (A. Agostini) Noot. (1986) 141, nom. inval. — Type: *Beccari 116* (holo FI; iso BM, K, L), Indonesia, Sumatra, Mt Singgalan.

Magnolia maingayi King (1889) 369; (1891) 208, t. 45 B; C. Curtis (1894) 71; Finet & Gagnep. (1905) 36; Merr. (1921) 251, excl. coll. *Beccari 2661, 3660*; Ridl. (1922) 13; Burkill (1935) 1393; Meijer (1968) 9; Cockburn (1980) 55. — Type: *Maingay 17* (holo CAL; iso K, L), Malaysia, Malaya, Perak, Is. Pinang.

Magnolia aequinoctialis Dandy (1928) 185. — Type: *Houtvester Sumatra's Oostkust 25* (holo BO; iso L), Indonesia, Sumatra, Karolanden.

Leaves: petiole 0.3–1.2 cm long, 1–3 mm diam.; blade elliptic to slightly obovate, 12–24 by 4–9 cm, 0.1–0.25 mm thick when dried, base cuneate to rounded, apex shortly acuminate, acumen 0.5–2 cm long, midrib in lower surface pubescent or glabrescent, lateral nerve pairs 13–22. *Flowers*: outer tepals obovate, 2–4 by 1–1.2 cm; inner tepals obovate, 2–2.5 by 0.9–1.1 cm; stamens 6–9 mm long, connective with c. 1 mm long acute appendage or not. *Follicetums* cylindric, 4–8 by 2–3 cm, densely covered with pubescent or woolly hairs; carpels 10–45; gynophore absent; peduncles densely covered with pubescent or woolly hairs, 2–5 cm long, 1.5–3.5 mm diam.; cluster of perianth and stamen scars 1–1.5 cm long.

Distribution — Malaysia (Malaya, Sabah, Sarawak), Indonesia (Sumatra), and Singapore.

7. Magnolia pealiana King

Magnolia pealiana King (1891) 210. — *Magnolia membranacea* var. *pealiana* (King) P. Parm. (1896) 200. — *Michelia pealiana* (King) Finet & Gagnep. (1905) 42. — Type: *Mann s.n.* (holo CAL; iso K, L sheet 908.126-1100 and 908.126-1120), India, Assam, Makum forest.

Twigs covered with appressed, pale yellow, sericeous hairs at first, soon becoming glabrous, 2–3 mm diam.; buds covered with appressed, pale yellow, sericeous hairs, 2–3 cm long, 2.8–3.1 mm diam. *Leaves* hairy at least when young; petiole 5–8 mm long, c. 3 mm diam., dilated at base; blade elliptic to narrowly elliptic, 20–30 by 7–10 cm, membranous, c. 0.2 mm thick when dried, base round to obtuse, apex acute to mucronate, acumen c. 8 mm long, lateral nerve pairs 23–25, upper surface glabrous, lower surface puberulous at first, then becoming glabrous, lacking papillae. *Flowers*

c. 6 cm diam.; outer tepals 3, spatulate, c. 5 by 1 cm; inner tepals 6, spatulate, c. 4 by 0.9 cm; stamens c. 1.2 cm long, connective with c. 2 mm long acute appendage, filaments c. 2 mm long; gynoecium partly exposed above stamens. *Follicetums* cylindric, c. 8 by 2.5 cm, glabrous; carpels 30–40, basally connate in developing fruit then separating and becoming free at dehiscence, slightly lenticellate, the length of the face that makes contact with the next carpel more than 3/4 of the carpel length; gynophore c. 15 mm long; peduncles pubescent, 7–10 cm long, c. 2.7 mm diam.; pedicles absent; cluster of perianth and stamen scars c. 7 mm long.

Distribution — India (Assam).

EXCLUDED NAME

Magnolia annamensis Dandy var. *affinis* Gagnep. (?); Gagnep. (1938) 39. See p. 330.

ACKNOWLEDGEMENTS

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REFERENCES

Agostini, A. 1926. Atti Reale Accad. Fisiocrit. Siena, ser. 10, 1: 184.

Backer, C.A. & R.C. Bakhuizen van den Brink f. 1963. Flora of Java 1: 96–98. Groningen.

Burkill, I.H. 1935. A dictionary of the economic products of the Malay Peninsula: 1392–1393. London.

Chen, B.L. & H.P. Nooteboom. 1993. Notes on Magnoliaceae III: The Magnoliaceae of China. Ann. Missouri Bot. Gard. 80: 999–1104.

Cockburn, B.F. 1980. Trees of Sabah Vol. II. Sabah forest records 10: 55.

Curtis, C. 1894. Catalogue of the flowering plants and ferns found growing wild in the island of Penang. J. Straits Branch Roy. Asiat. Soc. 25: 71.

Dandy, J.E. 1927. The genera of Magnoliaceae. Kew Bull. 1927: 257–264.

Dandy, J.E. 1928. Malayan Magnolieae. Kew Bull. 1928: 183–193.

Dandy, J.E. 1930. New Magnolieae from China and Indo-China. J. Bot. 68: 209.

Dandy, J.E. 1948. Magnolia nitida. Bot. Mag. 165: t. 16.

Dandy, J.E. 1950. A survey of the genus Magnolia together with Manglietia and Michelia. Camellias and Magnolias Conf. Rep. (Roy. Hort. Soc.): 64–81.

Finet, E.A. & F. Gagnepain. 1905. Magnoliaceae. Bull. Soc. Bot. France 1, 4: 30–48.

Gagnepain, F. 1938. Flore générale de l'Indo-Chine. Supplément 1: 39. Paris.

Hooker, J.D. & T. Thomson. 1855. Magnoliaceae. In: W. Pamplin (ed.), Flora indica: 79. London.

Hooker, J.D. & T. Thomson. 1872. Magnoliaceae. In: J.D. Hooker (ed.), The flora of British India 1: 41–44. London.

Kim, S. 2001. Phylogeny and classification of the Magnoliaceae. PhD dissertation, Seoul National University, Seoul.

Kim, S., C.-W. Park, Y.-D. Kim & Y. Suh. 2001. Phylogenetic relationships in family Magnoliaceae inferred from ndhF sequences. Amer. J. Bot. 88: 717–728.

King, G. 1889. Materials for a flora of the Malayan Peninsula. J. Asiat. Soc. Bengal, Pt. 2, Nat. Hist. 58: 369.

King, G. 1891. The Magnoliaceae of British India. Ann. Roy. Bot. Gard. (Calcutta) 3: 197–223.

Koorders, S.H. 1912. Exkursionsflora von Java 2: 237–241. Jena.
Koorders, S.H. & Th. Valeton. 1896. Meded. Lands Plantentuin 17: 145–169, 314–315.
Koorders, S.H. & Th. Valeton. 1918. Atlas der Baumarten von Java 4: t. 800. Leiden.
Koorders-Schumacher, A. 1913. Systematisches Verzeichnis 1, Fam. 95: 2.
Korthals, P.W. 1851. Indische Magnoliaceae. Ned. Kruidk. Arch. 2: 93–98.
Law, Y.W. 1984. A preliminary study on the taxonomy of the family Magnoliaceae. Acta Phytotax. Sin. 22: 80–109.
Law, Y.W. 1996. Flora Reipublicae Popularis Sinicae. Vol. 30, 1: 82–269. Science Press, Beijing.
Meijer, W. 1968. The Magnoliaceae of Sabah. Bot. Bull. Herb. Forest Dept., Sabah 11: 7.
Merrill, E.D. 1921. A bibliographic enumeration of Bornean plants: 251. Singapore.
Miquel, F.A.W. 1858. Flora Indiae Batavae 1: 13–18.
Miquel, F.A.W. 1860. Flora Indiae Batavae. Suppl.: 152–153.
Miquel, F.A.W. 1868. Magnoliaceae. Ann. Mus. Bot. Lugduno-Batavi 4: 68–73.
Nooteboom, H.P. 1985. Notes on Magnoliaceae, with a revision of Pachylarnax and Elmerrillia and the Malesian species of Manglietia and Michelia. Blumea 31: 65–121.
Nooteboom, H.P. 1986. Magnoliaceae. In: T.C. Whitmore & I G.M. Tantra (eds.), Tree flora of Indonesia, check list for Sumatra: 140–144. Bogor.
Nooteboom, H.P. 1987. Notes on Magnoliaceae II, revision of Magnolia section Maingola (Malesian species), Aromadendron, and Blumiana. Blumea 32: 343–382.
Nooteboom, H.P. 1993. Magnoliaceae. In: K. Kubitzki (ed.), Families and genera of vascular plants, vol. 2: 391–401. Springer, Berlin.
Parmentier, P.E. 1896. Magnoliaceae. Bull. Sci. France Belgique 27: 200.
Raju, D.C.S. 1993. Magnoliaceae. In: B.D. Sharma, N.P. Balakrishnan, R.R. Rao & P.K. Hajira (eds.), Flora of India Vol. 1: 163–183. Botanical Survey of India, Calcutta.
Rant, A. 1929. De Javaansche gebergteflora als bewijs van een vroegere verbinding van Java met het vasteland van Azië. Natuurw. Tijdschr. Ned.-Indië 89: 446.
Ridley, H.N. 1922. The flora of the Malay Peninsula 1: 12–18.
Rohlf, F.J. 1992. NTSYS-pc. ver. 1.70. Exeter software, New York.
SAS Institute Inc., 1988. SAS/GRAPH user's guide, release 6.03 ed., Carry.

IDENTIFICATION LIST

Magnolia

1 = *M. annamensis* Dandy
2a = *M. carsonii* Dandy ex Noot. var. *carsonii*
2b = *M. carsonii* Dandy ex Noot. var. *drymifolia* Noot.
2c = *M. carsonii* Dandy ex Noot. var. *phaulanta* (Dandy ex Noot.) S. Kim & Noot.
3 = *M. cathcartii* (Hook.f. & Thomson) Noot.
4 = *M. griffithii* Hook.f. & Thomson
5 = *M. gustavii* King
6a = *M. macklottii* (Korth.) Dandy var. *macklottii*
6b = *M. macklottii* (Korth.) Dandy var. *beccariana* (A. Agostini) Noot.
7 = *M. pealiana* King

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Beccari 116 (type): 6b.
CF series 20805: 6b; 30964: 6b; 45514: 6b; 98158: 6b — P. Chalermglin 440216: 5 — Chevalier 38877 (type): 1 — Clarke 25456C: 3; 25456F: 3; 25456V: 3 — Clemens 20520A: 2b; 26707: 6a; 26746: 2a; 26985: 6a; 28439 (type): 6a; 28753: 6a; 28866: 6a; 28886: 6a; 29520: 2b; 29775 = 28126: 6a; 30298: 6a; 30720: 2a; 31266: 2a; 31941: 2b; 32451: 2b; 33701: 2b; 50271: 2a; 50508: 2a; 50574: 6a — Curtis 292: 6b.
De Wilde c.s. 13039: 6b; 13210: 6b; 14191: 6b; 15454: 6b; 16822: 6b; 16855: 6b — Dransfield 7452: 6a — Dumas 1583: 6a.

FRI/bb series 4134: 2b; 6803: 6b; 9662: 2b; 18915: 6a; 19581: 2c; 23355: 2b; 24172: 2a; 26276: 2c; 26296: 2c; 26637: 2a; 28268: 2a; 28295: 2a; 29194 (type): 2c — FRI/Ja series 3313: 6a.
Gamble 650: 3; 1883A: 3; 8364: 3 — Grashoff 1038: 6a — Grierson & Long 3082: 3 — Griffith s.n. (type): 4.
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Lace 2212: 3 — Laumenier TFB 121: 6a.
Maingay 17 (type): 6b — Mann (L 908.126-1038): 7; (L 908.126-1048): 7; (type; L 908.126-1100, 908.126-1120): 7; (K: Sept. 1, 1890): 4; (type; L 908.126-1830): 5; (L 908.126-1854): 5; (K: Dec., 1889): 5 — Meijer 5883: 6b.
Nooteboom 937: 6a; 1750: 6b; 4612 (type); 2b.
Parkinson 397: 4 — Peal 178: 4 — Poilane 35782: 3 — Poore 1339: 6b.
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The accepted names are in roman type, the synonyms in *italics* and the new name in **bold**. Numbers refer to the species numbers as given in the text.