Malayan Forest Records No. 49
Series II: Seed Plants, Volume 5

Flora of Peninsular Malaysia

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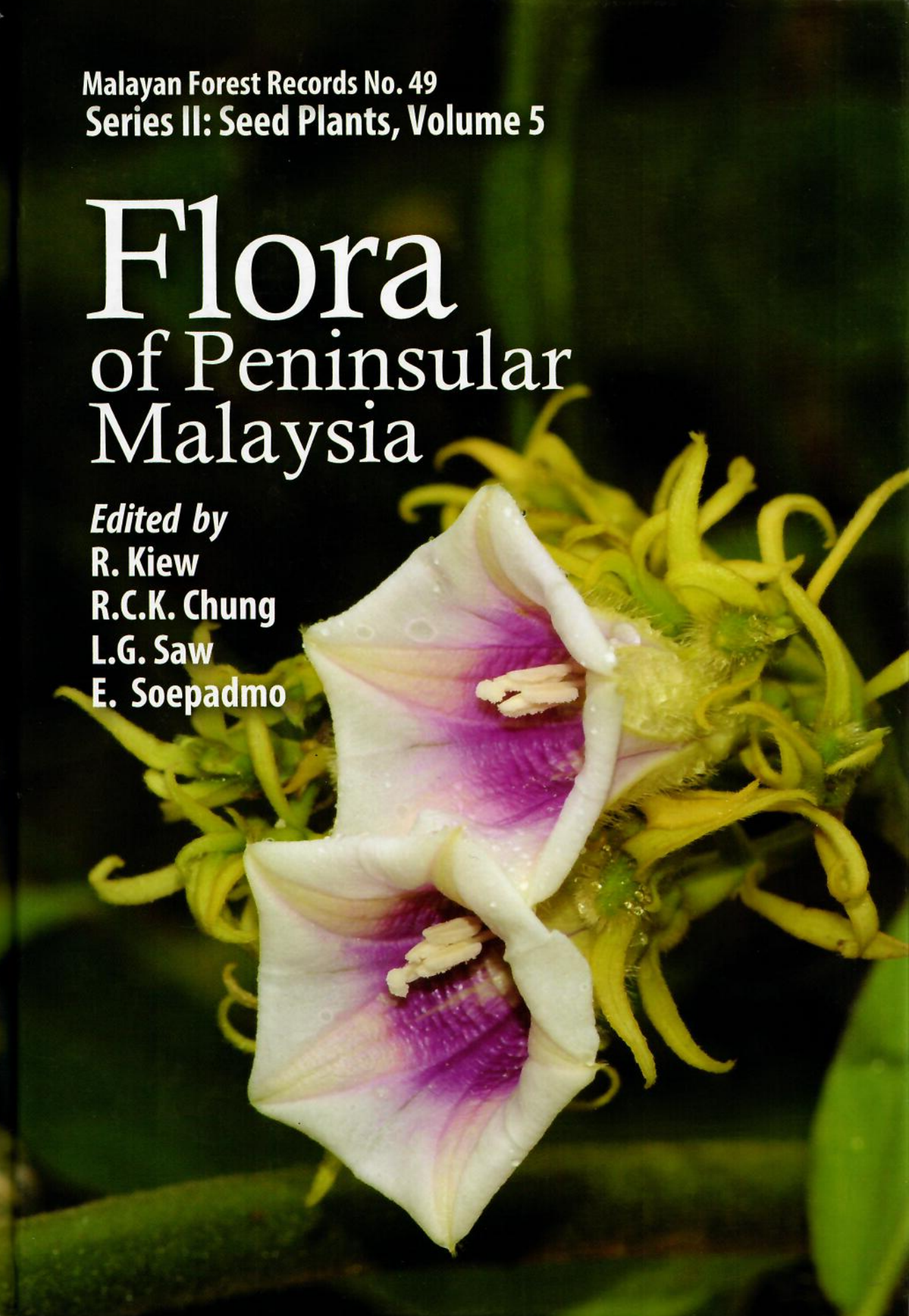

FLORA
OF
PENINSULAR MALAYSIA

Series II: Seed Plants

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NYMPHAEACEAE

R. Kiew

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Salisb., Ann. Bot. (Koenig & Sims) 2 (1805) 69; Schneider & Williamson, Fam. Gen. Vasc. Pl. 2 (1993) 486; Heywood *in* Heywood *et al*., Flow. Pl. Fam. World (2007) 231; Mabberley, Pl. Book, 3rd ed. (2008) 591. **Synonym:** Barclayaceae Li, Amer. Midland Nat. 54 (1955) 33.

Aquatic perennial herbs rooted in substrate, with long horizontal rhizomes, sometimes tuberous or with a short erect stem, rarely marsh plants (*Barclaya rotundifolia*). Stipules present or lacking. Leaves spirally arranged, floating, submerged or rarely emergent (*B. rotundifolia*); with or without thorns on the petiole and lower lamina surface; petioles long; lamina simple, peltate or attached at lamina base, ovate to orbicular or rarely ribbon-like (*B. longifolia*), base cordate or sagittate, margin entire or dentate or upturned (*Victoria* spp.). **Flowers** often large and showy, actinomorphic, bisexual, solitary, held above the water surface on long pedicels, organs spirally arranged; sepals 4–9, green or coloured (or petaloid in *Nuphar*); petals 3 to many (or absent in *Ondinea*), yellow, pink, red, blue, purple or white; stamens 14 to many, free, laminar or with a distinct filament; gynoecium inferior (*Barclaya*) or semi-inferior or superior (*Nuphar* and *Ondinea*), carpels 3–40, joined or partly free; placentation lamellar. **Fruit** a spongy berry, splitting when the mucilage inside swells or indehiscent. **Seeds** many, arillate (*Nymphaea* and *Ondinea*) or aril lacking; perisperm copious, endosperm scanty.

English name. Waterlilies.

Distribution. Cosmopolitan in tropical and subtropical regions, with 6 genera and *c*. 70 species; *Nymphaea* is the most speciose and widespread genus with *c*. 40 species, *Victoria* (2 species) in S America, *Nuphar* (18 species) in north temperate regions, *Barclaya* (3 species) in W Malesia; *Euryale* (1 species) in E Asia, *Ondinea* (1 species, sometimes included in *Nymphaea*, Mabberley, 2008) in W Australia. In Peninsular Malaysia, the family is represented by 2 genera (*Barclaya* and *Nymphaea*) and 5 species.

Ecology. Confined to freshwater in lakes, ponds, rivers and streams, ditches, canals, etc., rooted in mud. The *Victoria* waterlilies have the largest leaves of all waterlilies and can grow to 2 m diameter with an upturned margin to 10 cm high and can support 40–75 kg. Its showy flowers 30–40 cm in diameter open white but turn pink on second day and are scented of pineapple. Waterlilies are insect pollinated either by bees (day flowering species) or beetles (night flowering species, some of which, e.g. *Victoria* spp., are thermogenic). The fruit often ripens below the water surface. Seeds of some species have arils that enclose an air bubble and so the seed floats and are dispersed by water currents (*Nymphaea*) or the seeds are covered in spines (*Barclaya*) that suggest they could become attached to the fur or feathers of animals or birds (Mabberley, 2008).

Uses. The main value of the family is the ornamental waterlilies of which there are many species and hybrids (Slocum, (2005) Waterlilies and Lotuses), including the iconic Amazon waterlily, *Victoria amazonica* (Poeppig) Sowerby, a native of S America. In hothouse cultivation, it is treated as an annual. The colourful submerged leaves of *B. longifolia* are valued as an aquarium plant (http://www.Diszhal.info/english/plants/en_Barclaya_longifolia.php (19 Oct 2009). Several species, such as *Nymphaea nouchali*, yield edible seeds and rhizomes.

Taxonomy. Based on similarities in aquatic habit, earlier accounts for Peninsular Malaysian Nymphaeaceae (Hooker *f.* & Thomson, Fl. Brit. India 1 (1875) 113; King, J. As. Soc. Bengal 58, 2 (1889) 388; Ridley, Fl. Malay Pen. 1 (1922) 115) and Backer & Bakhuizen *f.*, Fl. Java 1 (1964) 147. included the lotus, *Nelumbo*, which is now recognised as a distinct family, Nelumbonaceae (Lee, Fl. Pen. Malay. 2, 1 (2010) 151) as is S American Cabombaceae (Siti-Munirah, Fl. Pen. Malay. 2, 4 (2013) 25).

Li (Amer. Midlands Nat. 54 (1955) 33) separated *Barclaya* as a distinct family, Barclayaceae Li. This was accepted by both Takhtajan (Flow. Pl. (1969) 207) and Mitra (Fl. India 1(1993) 443). *Barclaya* differs from the other genera in a number of characters: the gynoecium is completely inferior, the petals are joined into a tube, which is lobed at the apex, the stamens are epipetalous, pendent and attached scattered on the inner surface of the corolla tube, ovules are orthotropous (anatropous in all the other genera) and the seeds do not have an aril. However, molecular analysis has shown that it belongs in Nymphaeaceae (Les *et al*., Syst. Bot. 24 (1999) 28) and three subfamilies are recognised: subfam. Nupharoideae (*Nuphar*), subfam. Barclayoideae (*Barclaya*) and subfam. Nymphaeoideae (*Euryale*, *Nymphaea*, *Ondinea*, *Victoria*). Heywood (2007) recognised just two subfamilies: Nupharoideae and Nymphaeoideae with *Barclaya* included in the latter.

The fossil record shows that Nymphaeaceae is one of the most ancient groups of flowering plants with fossils dating back to the early Cretaceous (Friis, Pedersen & Crane, Nature 410 (2001) 357–360) and it was widely distributed in the Tertiary, and indeed displayed much greater diversity in the past. While its aquatic habit is considered specialised, the waterlily flower with many, free, spiral flower parts, lack of differentiation into small green sepals and larger colourful petals and the laminar stamens place it among the basal ('most primitive') group of flowering plant families.

Key to genera

Leaves submerged or held just above the water level. Flowers not showy, hypogynous; corolla forming a tube; stamens pendent on the inner surface of corolla tube. Seed spiny, without an aril ..... **1. Barclaya**

Leaves floating on the water surface. Flowers showy, perigynous; petals many, free; stamens erect and not attached to the corolla. Seeds smooth or papillose or hairy, arillate ..... **2. Nymphaea**

BARCLAYA Wall.

(Robert Barclay, 1751–1830, London brewer and friend of N. Wallich)

Trans. Linn. Soc. Lond. 15 (1827) 442, *nom. cons*.; Hooker *f*. & Thomson, Fl. Brit. India 1 (1872) 115; King, J. As. Soc. Beng. 58, 2 (1889) 390; Ridley, Fl. Malay. Pen. 1 (1922) 116; Hu, Dansk. Bot. Arkiv. 23, 4 (1968) 535, fig. 1; Schneider & Williamson, Fam. Gen. Vasc. Pl. 2 (1993) 491, fig. 104F. **Synonym:** *Hydrostemma* Wall. *in* Taylor & Phillips, Phil. Mag. n.s. 1 (1827) 454; Mabberley, Taxon 31 (1982) 68.

Perennial herbs; rhizome fleshy, creeping. **Leaves** in rosettes, *submerged or just above the water surface* (*B. rotundifolia*); lamina lanceolate to ovate to orbicular, margin entire or undulate; venation pinnate. **Flowers** *hypogynous*; buds narrowly ellipsoid; sepals narrowly lanceolate, opening wide, pale yellow or greenish brown, (4–)5, free, *strongly keeled elongating into a long apical tip*; petals deep pink or purple or red, *connate into a corolla tube* adnate to the syncarpous ovary, lobes (8–)12(–many), in several series inserted at different levels; stamens many, magenta, *epipetalous within the corolla tube*, *pendent*, staminodia 10–20, above the stamens; ovary syncarpous, carpels 8–14, carpellary appendages encircling the stigmatic cup. **Berry** globose to ellipsoid, spongy, dehiscing irregularly, sepals persistent. **Seeds** many, globose or ellipsoid, *c*. 1 mm diameter, embedded in mucilage or in spongy tissue, testa *with long, soft spines*, *without an aril*.

Distribution. India (Andaman Is.), Myanmar, Thailand, Sumatra, Peninsular Malaysia, Singapore, Borneo and New Guinea. Three species, all of which are native in Peninsular Malaysia.

Ecology. In shaded primary lowland forest, in freshwater or peat swamp forest or in waterlogged hollows or in clear, shallow streams on fine clay substrate or on fine gravel, sometimes persisting after disturbance. Only *B. rotundifolia* holds its leaves above the water surface; in *B. longifolia* and *B. motleyi* the leaves are submerged or when exposed by falling water levels lie prostrate on the wet substrate. The flowers of all species are held and open above the water surface, although Williamson & Schneider (1994) have reported that *B. longifolia* is sometimes cleistogamous and self-pollinating with flowers remaining closed and not emerging above the water surface. Exclusion experiments also show that *B. motleyi* flowers are self pollinating (Williamson & Schneider, 1994). The sepals open wide, their pale dull colour contrasts with the maroon or purple corolla. Williamson & Schneider (1994) suggested flies as a possible pollinator for *B. rotundifolia* based on observations of flies in the vicinity of the flowers and drowned in fluid in the stigmatic cup. They reported this species blooms for three days, the flowers opening in the morning when they produce a pungent fermenting odour and closing at dusk. Its flowers have also been reported as smelling of rotten meat (*Poore 6415*). *Barclaya motleyi* produces a strong stink at night (Abdullah Piee, *pers. comm*.) suggesting beetle pollination for that species. Flower structure also indicates beetle pollination because the apical corolla lobes do not open widely and so would restrict access for flies. After pollination, the sepals and corolla tube persist, while the stalk bends so that the fruit ripens at or below the water surface. The pericarp disintegrates or ruptures irregularly as the mucilage inside swells and the spongy pericarp tissue enables the fruit to float so it may be dispersed by water currents. The spiny seeds may be further dispersed on the fur or feathers of mammals or birds. In *B. motleyi* seeds germinate within 48–72 hours on wet mud but do not germinate when submerged (Lok *et al*., Nature in Singapore 2 (2009) 237) unlike those of *B. longifolia* that readily germinate submerged. *Barclaya* species also propagate vegetatively by runners or by small tubers.

Uses. In Continental Europe and N America *B. longifolia* is traded as an aquarium plant valued for its reddish submerged leaves.

Note. Several authors, Hooker *f*., Icon Pl. (1852) 809; Li (1955); and Hotta (Acta Phytotax. Geobot. 22 (1966) 9), interpreted the sepals as bracts and the corolla as the perianth. Developmental anatomy confirms the outer organs as sepals (Williamson & Schneider, Pl. Syst. & Evol. [Suppl.] 8 (1994) 159–173).

Key to Barclaya species

1. Marsh plants. Leaves held above the water surface; petiole stout, (3–)6(–9) mm thick when dry; lamina orbicular, base deeply cordate with the lobes close, sometimes overlapping, in life green, glossy and bullate above, thick-textured, veins very prominent beneath ..... **3. B. rotundifolia**
   Aquatic plants. Leaves submerged or laying flat on the waterlogged substrate; petiole thin and flexible, (1–)2–3(–5) mm thick when dry; lamina narrowly oblong or linear or broadly oval to ovate-rotund, base sagittate or truncate or if cordate then lobes are wide apart, in life reddish or dark purple-green above, dull and flat, thin-textured, veins not prominent beneath 2

2. Lamina narrowly oblong or linear, base sagittate, 16–24 × 2.5–4 cm, in life reddish ..... **1. B. longifolia**
   Lamina broadly oval to ovate-rotund, base truncate or cordate, 4–10 × 3.5–8 cm, in life dark purple-green ..... **2. B. motleyi**

1. **Barclaya longifolia** Wall. Map 1

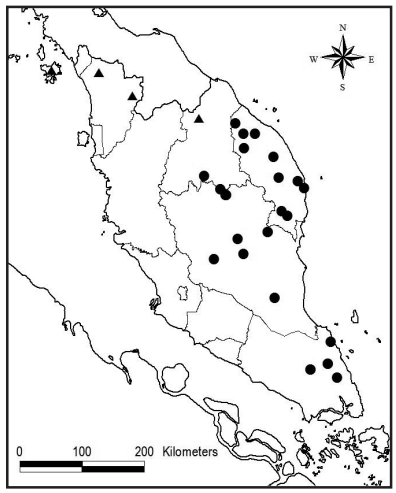
(Latin, *longus* = long; *folia* = leaf)

Trans. Linn. Soc. Lond. 15 (1827) 442, *t*. 18; Hooker *f*., Icon Pl. (1852) 809, *t*. 810; Hooker *f*. & Thomson, Fl. Indica 1 (1855) 246, Fl. Brit. India 1 (1872) 115; King, J. As. Soc. Beng. 58, 2 (1889) 390, Ridley, Fl. Malay. Pen. 1 (1922) 118; Hu, Dansk. Bot. Arkiv. 23, 4 (1968) 535, fig. 1; Mitra, Fl. India 1 (1993) 443. **Type:** *Wallich s.n*. August 1826 Pegu, Myanmar (holotype BM barcode 000574910; isotype K-W). **Homotypic synonyms:** *Barclaya oblonga* Wall., Numerical list 7260, *nom. nud*.; *Hydrostemma longifolia* (Wall.) Mabb., Taxon 31 (1982) 68.

Submerged aquatic herb with a branching white rhizome. **Leaves:** petiole *flexible*, 9–18 cm long, 1.5–3 mm diameter when dry, glabrous or ferrugineous at base; lamina *deep green or reddish above*, red-brown beneath, very thin, *narrowly oblong*, *16–24 × 2.5–4 cm*, base *sagittate*, basal lobes 0.2–0.7 cm long, margin undulate, narrowed to an obtuse apex; veins 11–20 on each side of midrib, fine, *scarcely raised above and beneath*; intercostal venation obscure. **Flowers:** pedicel (4–)15–30 cm long, glabrous or with sparse short white hairs; sepals 5, purplish brown or green, narrowly lanceolate, (20–)25–30 × (2.5–)4–6 mm, apex long attenuate with an apiculus 2–4 mm long or sometimes truncate, outer surface glabrous to glabrescent and keeled, inner surface glabrous, pink; corolla 20–25 mm long, tube deep purple or deep red to 9 mm long, lobes 12–15, 7–9 × 3–5 mm, rounded and cucullate, outermost three greenish opening horizontally with a curved tip, middle four larger and magenta, innermost

eight lobes reduced and white; stamens *c*. 21, anthers subsessile, white, oblong, to 1.5 mm long, tip slightly apiculate; ovary with stigma ring concave, stigmas *c*. 9, *c*. 1.3 mm long. **Berry** globose, 1.5–2 cm diameter, splitting into 2–3 pieces, exposing white jelly and seeds. **Seeds** globose, spiny.

Distribution. India (Andaman Is.), Myanmar (Pegu, Tenasserim), E & S Thailand, Laos, Vietnam and Peninsular Malaysia. In Peninsular Malaysia only in the extreme north in Kedah (Langkawi Is., *Curtis 2572*, *Keng 110*; Bk. Wang, *Md Haniff SFN 644*) and Kelantan (Setir, *Kiew RK 5272*).



Map 1. Distribution of *Barclaya longifolia* (▲) and *B. rotundifolia* (●).

Conservation status. Global Status—Least Concern. Although it is noted that its habitat is declining there are no major threats recorded (Juffe Bignoli (2013) in IUCN Red List of Threatened Species ver. 2014.1).

Peninsular Malaysia Red List—Endangered B2ab(iii). Its populations do not grow within any Totally Protected Area and the streams where they grow are extremely vulnerable to siltation from land use change (Assessed by C.L. Lim).

Ecology. It grows in light shade in small streams with a sandy or fine gravel substrate with a moderately strong current or on the edge of muddy slow streams. Its leaves grow submerged to 30 cm deep. In Thailand, its flowers were recorded as smelling of 'decomposing prawns' (*P.C.Boyce 903*). In cultivation, it flowers and fruits seasonally in July. The flowers are self-pollinating whether produced above or below the water surface, in the latter case the flowers are cleistogamous, and produce many seeds that readily germinate.

Uses. Traded commercially as 'Orchid Lily', it comes in two colour forms, the one with red leaves is more attractive for aquarists than the green-leaved form. In aquaria its leaves can grow to 30–80 × 6.5 cm long. It is propagated from seed or from pieces of the rhizome (http://www.Diszhal.info/english/plants/en_Barclaya_longifolia.php (19 Oct 2009). In aquaria, it periodically undergoes a dormant period when the leaves die back after which it produces new leaves.

2. **Barclaya motleyi** Hook.*f*. Map 2

(James Motley, miner and naturalist, 1822–1859, massacred together with his wife and three small children in the Banjarmasin War[1], Borneo)

Trans. Linn. Soc. Lond. 23 (1860) 157, *t*. 21, fig. 1–4; King, J. As. Soc. Beng. 58, 2 (1889) 390 [as *B. mottleyi*]; Ridley, Fl. Malay. Pen. 1 (1922) 116, fig. 10, *pro parte*; Leach & Osborne, Freshwater Pl. Papua New Guinea (1985) 192. **Type:** *J. Motley 956*, Banjarmasin [Bangarmassing], Borneo Aug 1857 (holotype K, barcode K000442105; isotype K, barcode K000442106). **Homotypic synonym:** *Hydrostemma motleyi* (Hook.*f*.) Mabb., Taxon 31 (1982) 68. **Heterotypic synonyms:** *Barclaya motleyi* [as *B. mottleyi*] Hook.*f*. var. *kunstleri* King, J. As. Soc. Beng. 58, 2 (1889) 390; *B. kunstleri* (King) Ridl. Fl. Malay. Pen. 1 (1922) 117, Stone, Malay. Nat. 32, 2 (1976) 20, fig. 1, Keng, Order Fam. Malay. Seed Pl. (1983) fig. 21; *Hydrostemma kunstleri* (King) B.C.Stone, Gard. Bull. Sing. 35 (1982) 71. **Type:** Peninsular Malaysia, *Kunstler 10866*, Bera, Perak, Aug 1886 (lectotype CAL, *n.v.*; isolectotype K, barcode K000442104).

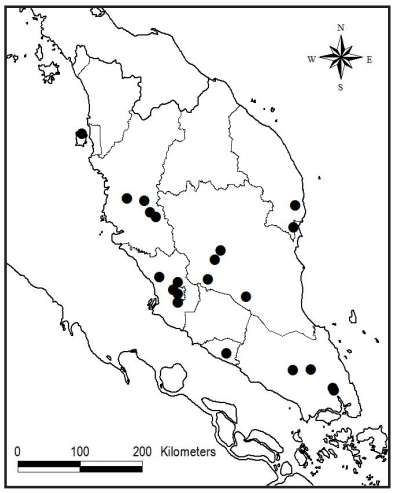
Submerged aquatic herb with a long thin branching rhizome, nodes rooting and producing leaves. **Leaves:** petiole reddish, *thin and flexible*, 8.5–27.5 cm long, (*1–*)*2–3*(*–5*) *mm diameter when dry*, densely pubescent becoming glabrescent; lamina *brownish or purplish green or dull green above*, yellowish, reddish or purplish brown or deep magenta beneath, thin, *broadly oval to obovate or ovate-rotund*, rarely rotund, *4–10 × 3.5–8 cm*, base *slightly cordate*, lobes 0.3–1.5 cm long and *lobes far apart or truncate*, sometimes unequal, margin undulate, apex rounded, sometimes obtusely acute; lateral veins 3–5 pairs, sometimes the lowermost two pairs arising together from base of the midrib, plain above, *slightly prominent beneath*, glabrous to densely pubescent; intercostal veins obscure. **Flowers:** pedicel (5–)10.5–19 cm long, lengthening to (9.5–)22–26.5 cm in fruit, pubescent, sparsely clothed with short white hairs or glabrous; sepals 5, dull purple-brown or pink, narrowly lanceolate 14–50 × 3–5 mm, outer surface slightly hairy, slightly keeled, sometimes apex abruptly narrowed into an apiculus 2–4 mm long; corolla tube dark red, purplish or greenish yellow, to 8–9 mm long, *c*. 4.5 mm wide, with (5–)12–15 lobes, 7–9 × 2–5 mm, rounded and hood-like, 3 outermost lobes greenish, middle four larger and pink-magenta, eight innermost lobes reduced and white; stamens *c*. 21, anthers subsessile, white, tinged pink, oblong, to 1.5 mm long, tip slightly apiculate; ovary with concave stigma ring, locules *c*. 9. **Berry** globose, pinkish, 1.5–2.2 cm diameter. **Seeds** spiny, globose, black.

Distribution. Peninsular Thailand (Setul), Peninsular Malaysia (Penang, Perak, Melaka, Selangor, Terengganu, Pahang, Johor), Singapore, Borneo (Sarawak and Kalimantan, apparently absent from Sabah) and New Guinea.

Conservation status. Least Concern (Assessed by C.L. Lim).

Ecology. In freshwater or peat swamp forest in deep shade in stagnant or slow-flowing clear streams with fluctuating water levels where its leaves may be submerged in water to *c*. 65 cm deep or in dry periods lie on the water-logged mud. It sometimes grows together with *Cryptocoryne* (Araceae) species. In Peninsular Malaysia, it has been collected in flower in February and March and again in November and December suggesting it flowers seasonally.

[1]Banjarmasin War was a colonial war triggered by the Dutch installing Tamjied Illah, an illegitimate grandson, instead of Hidayatullam, the legitimate son, to succeed as the Sultan of Banjarmasin.



Map 2. Distribution of *Barclaya motleyi*.

Taxonomy. *Barclaya motleyi* is distinct from *B. rotundifolia* in being truly aquatic, its leaves thriving underwater to a depth of *c*. 30 cm. When water level drops, its thin, flexible petiole is unable to support the lamina, which lies on the substrate surface. The lamina is distinct from that of *B. rotundifolia* in being dull brownish or purplish green above, thin with veins scarcely prominent on the lower surface, and if the base is cordate, the lobes are smaller and far apart.

Its leaves are very variable in both size and shape. The type sheet includes two plants, one with large leaves 9 × 9 cm, the other smaller plant with leaves 5 × 3.5 cm like those of var. *kunstleri* that Ridley (1922) later raised to species level. Other collections from Borneo also display a complete range in leaf size and shape. While plants from Perak and Selangor have smaller leaves, plants from Johor and Terengganu display a complete range of variation. Since var. *kunstleri* is not different in flower characters nor are there discontinuities in lamina size or shape, it can no longer be maintained as a distinct taxon, even at the varietal level, and is here reduced to synonomy.

The only *Barclaya* found in Sumatra most resembles *B. motleyi* in its submerged, purple-brown or brownish green leaves but the laminas are uniformly smaller (3.5–6.5 × 4–9 cm) and more rotund. The only name that has been applied to Sumatra plants is *Barclaya hirta* (Teijsm. & Binn.) Miq, Ill. Fl. Arcip. Ind. 44 (1870). However, the type specimen (*Teijsmann 3930* from Ipiel, Batang-Lekoo, Palembang Prov.) has not been located. Crusio & Bogner (Taxon 33 (1984) 518) reduced *B. hirta, B. motleyi* var. *kunstleri* and *B. rotundifolia* all to synonomy with *B. motleyi* but this is premature for *B. hirta* until complete flowering material is available and *B. rotundifolia* is certainly distinct. Crusio & Bogner did not provide any reason for their decision nor did they cite types.

3. **Barclaya rotundifolia** M.Hotta — Fig. 1, Map 1, Plate 48A–C

(Latin, *rotund* = rotund; *folia* = leaf)

Acta Phytotax. Geobot. 22 (1966) 9, fig. 3. **Type:** *Hotta 15579*, Borneo, Sarawak, Bintulu, Sg. Bejangang 23 Nov 1963 (holotype KYO *n.v.*; isotype SAR – not located, apparently never distributed).

Robust, perennial marsh plant with branching rhizome, 1–2 cm thick. Indumentum tawny tomentose comprised of long, multicelluar uniseriate hairs densely covering petioles, lower surface of veins, pedicel and sparsely on outer surface of sepals. **Leaves** in a spreading rosette *above the water surface*; petioles *stout*, (6.5–)10–20(–28) cm long, in life fleshy, (*3–*)*6*(*–9*) *mm diameter when dry*; lamina *dark green*, *glossy*, glabrous and *slightly bullate above*, beneath pale green or pale brown, *thick*, *orbicular* usually wider than long, (*6–*)*8–10*(*–17*) × *8–17.5 cm*, base *deeply cordate*, basal lobes rounded, to 4.5 cm long, *sometimes overlapping*, margin entire, apex rounded; lateral veins *very prominent beneath*, 6–8 pairs, lowest two pairs touching at base of midrib; intercostal venation prominent. **Flowers:** pedicel (3.5–)7–9.5(–13) cm long, brownish, shorter than petioles; sepals (4–)5, pale green to brownish purple, pink towards base, oblong-lanceolate, 30–35 × 3–8 mm, outside slightly keeled, keel prolonged into an apiculus 2–4 mm long; corolla tube deep violet-pink, dark red, pinkish maroon or brownish, 9–14 mm long, lobes 12–15, 9–15 × 3–5 mm, three outermost narrow and oblong, middle four shorter, and eight innermost rounded and cucullate; stamens with white oblong anthers to 1.5 mm long; ovary dirty light orange, stigmas in a ring of about 9, *c*. 1.3 mm long. **Berry** globose, 12–16 mm long, light green, crowned by remnant of persistent corolla tube. **Seeds** spiny, ellipsoid, *c*. 2 mm long.

Distribution. Peninsular Malaysia (Kelantan, Terengganu, Pahang and Johor) and Borneo (Brunei, Kalimantan, Sabah and Sarawak).

Conservation status. Least Concern (Assessed by C.L. Lim).

Ecology. On waterlogged fine clay substrate at the edge of freshwater swamp, shallow margins of slow flowing streams or in muddy hollows. In Peninsular Malaysia, it has been collected in flower throughout the year but peak flowering appears to occur in February to April and again in August.

It is strange that Hotta (1966) did not emphasise that this species is a marsh plant and not truly aquatic like the other two *Barclaya* species. In contrast, its robust, green leaves are held above the water surface on stout petioles. In fact, very rarely do notes on herbarium specimens record whether the leaves are submerged, floating or are held above the water surface. Nursery experiments showed that while *B. motleyi* continues to produce new leaves when permanently submerged, i.e. it is truly aquatic, *B. rotundifolia* when submerged produced no new leaves and the old ones gradually rotted away resulting in the death of the plant (Joanne P.C. Tan, *pers. comm*.). It can therefore withstand only limited periods of submersion. In Terengganu and Johor, both species grow in the same locality with *B. rotundifolia* forming gregarious colonies around the margin of the swamp forest and *B. motleyi* occurring submerged in deeper water.

Taxonomy. Although the type specimen was not distributed to SAR, the original illustration is quite unambiguous to characterise this distinct species. In Borneo, plants do not reach such a large size as those in Peninsular Malaysia, their petioles measuring 6–16.5 cm, lamina 5–9(12) × (5–)7–10 cm, pedicel 5.5–7 cm, and sepals 27–33 × 4–5 mm.

Ridley (1922) included the Kuala Teku, Pahang, population ("in a mud patch above Kuala Teku") in *B. motleyi*. Plants from this same population have been collected by most botanists climbing G. Tahan from the Pahang side.

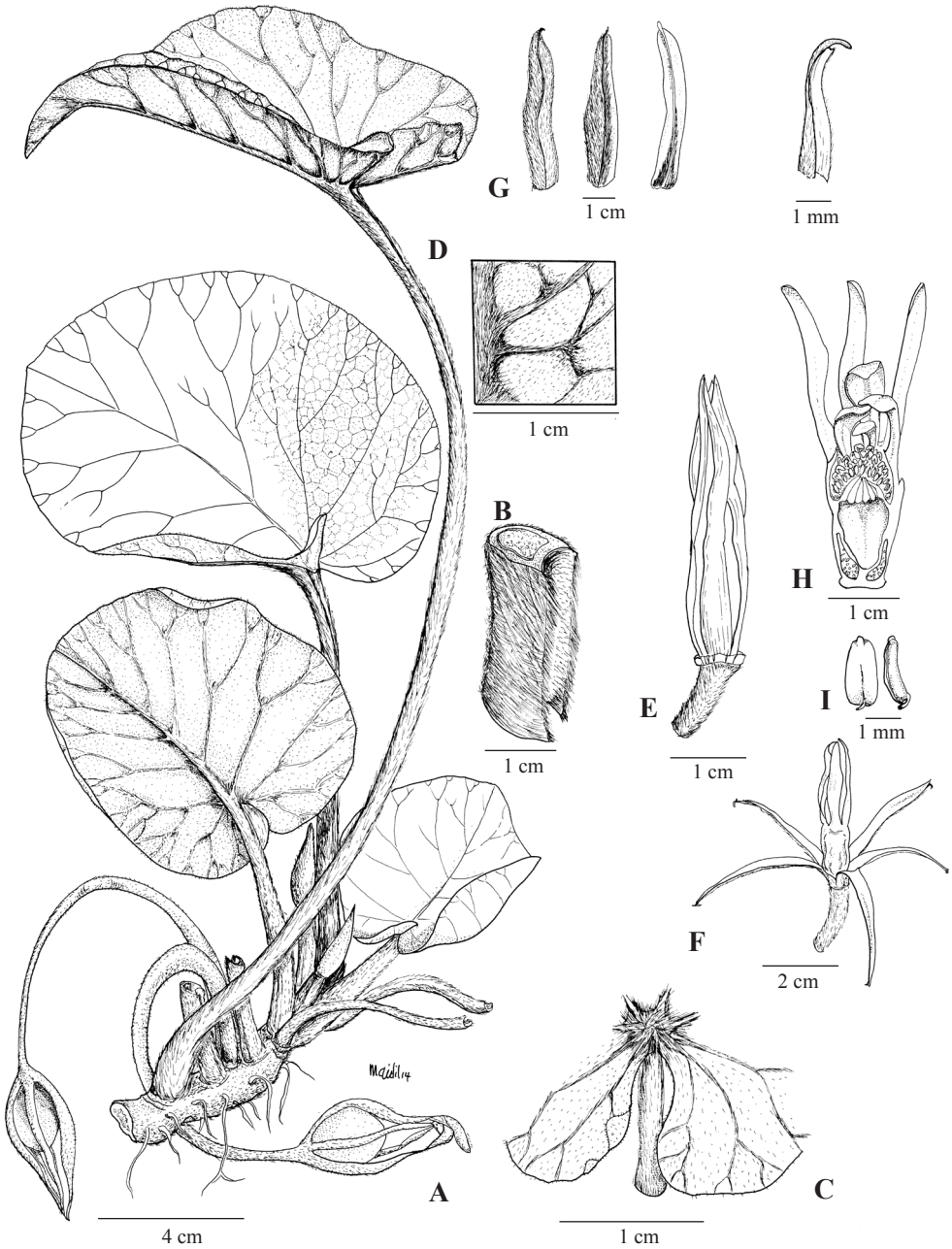


Figure 1. *Barclaya rotundifolia*. A, habit with buds and fruit; B, portion of the petiole; C, upper surface of junction of lamina and petiole; D, portion of lower surface of lamina with midrib and veins; E, flower bud; F, open flower; G, sepals; H, longitudinal section of flower with sepals removed; I, stamens. (All from live plant cultivated in KEP nursery.)

2. **NYMPHAEA** L.

(Greek, *Nymphaia*, referring to a water nymph)

Waterlilies, *Telipuk*

Sp. Pl. (1735) 510; Hooker *f.* & Thomson, Fl. Brit. India 1 (1872) 114; King, J. As. Soc. Beng. 58, 2 (1889) 389; Ridley, Fl. Malay. Pen. 1 (1922) 115; Backer & Bakhuizen *f.*, Fl. Java 1 (1964) 148; Mitra, Fl. India 1 (1993) 428; Schneider & Williamson, Fam. Gen. Vasc. Pl. 2 (1993) 491, fig. 104B, 105D.

Herbaceous, rhizomatous perennials. **Leaves** *mostly floating on the water surface*; lamina peltate, orbicular to sagittate, *usually with a deep sinus on one side*, usually glabrous above, margin entire, sinuate or dentate. **Flowers** *perigynous*; sepals free, (3–)4(–5); petals yellow, pink, red, blue or white, free, (6–)8–40(–50); stamens 10 to several hundred, *outermost petaloid, innermost with filaments,* erect and not attached to the corolla; ovary syncarpus at base, apocarpous to syncarpous apically, carpels (5–)8–35, style absent, carpellary appendages encircling the stigmatic cup, ovules numerous. **Berry** globular to ellipsoid, disintegrating irregularly. **Seeds** numerous, ovoid, testa smooth, papillose or hairy, arillate, embedded in mucilage, endosperm starchy.

Distribution. Cosmopolitan, *c*. 40 species. In Peninsular Malaysia represented by 2 species, one (*N. pubescens*) perhaps of cultivated origin.

Ecology. Open areas, fully exposed to sunlight; in Malaysia flowering throughout the year, the flowers are protogynous and last for 2–3 days. The fruits develop underwater often held down by a coiled pedicel. The seeds are dispersed by water, the fleshy, sac-like aril is air-filled so the seed floats (Mabberley, 2008).

Uses. Many waterlily species and hybrids are cultivated as ornamental plants. In Malaysia common species include the Cape blue waterlily, *N. capensis* Thunb., with toothed leaves attractively splashed with purple-red and fragrant, blue to purple flowers that open in the morning, and the yellow waterlily, *N. mexicana* Zucc., and the night lotus, *N. pubescens*.

Key to Nymphaea species

Leaf margin entire or slightly sinuate, glabrous beneath. Flowers violet-blue or purple with a bluish tinge, rarely white ..... **1. N. nouchali**

Leaf margin conspicuously toothed, veins pubescent beneath. Flowers usually white, sometimes tinged rosy pink ..... **2. N. pubescens**

1. **Nymphaea nouchali** Burm.*f.* Fig. 2, Map 3, Plate 48D

(*nouchali* = wrongly understood vernacular name from British India)

Fl. Indica (1768) 120; Backer & Bakhuizen *f.,* Fl. Java 1 (1964) 149; Nicolson, Suresh & Manilal, Regnum Veg. 119 (1988) 198; Mitra, Fl. India 1 (1993) 430; Slocum, Waterlilies and Lotuses (2005) 88. **Type:** India, Coromandel, *Burman s.n*. in Herb. Delessert (G, n.v.). **Synonym:** *Nymphaea stellata* Willd., Sp. Pl.

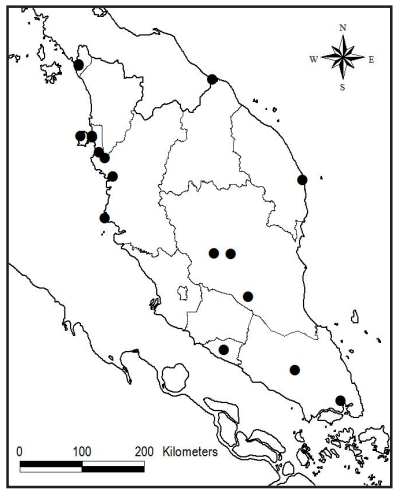
ed. 4, 2 (1799) 1153; Hooker *f.* & Thomson, Fl. Indica 1 (1855) 243, Fl. Brit. India 1 (1872) 114; King, J. As. Soc. Beng. 58, 2 (1889) 389; Ridley, Fl. Malay. Pen. 1 (1922) 116. **Type:** Soc. Unit. Frat. s.n. 1778 India (BM, barcode 000574884).

Leaves glabrous; petioles greenish brown, 17–50 cm long, 2–3 mm diameter; lamina broadly elliptic to circular, glossy green above, sometimes with brownish blotches, purplish beneath, (5–)13–24(–45) × (4.5–)8–20(–32) cm, base deeply cordate, sinus open, margin entire or slightly sinuate; midrib thick, lateral veins 4–5 pairs, brown, but not prominent beneath. **Flowers** held *c*. 30 cm above the water surface, opening 5–8(–12) cm across; pedicels reddish brown 11–29 cm long; sepals 4, pale brown or green with a pink margin, lanceolate, (17–)26(–44) × 7(–14) mm, joined at base for 6 mm, narrowed to a point; petals shorter than sepals, violet-blue, purple with bluish tinge, pale blue, rarely white (elsewhere rosy red), 7–18, elliptic, 16–25(–40) × 4–11 mm, apex acute; stamens 15–50, filaments broad, yellow *c*. 4 x 1.5 mm, anthers pale yellow to dirty white, 3–15 × *c*. 0.75 mm with a deep purple, pointed sterile appendage 1.5 mm long; ovary with 10–20 locules; stigma golden yellow. **Berry** globose to ovoid, 7–17 mm long, 8–25 mm diameter. **Seeds** green, broadly ellipsoid, 0.5–1 × 0.4–1 mm.

Vernacular names. *Telipuk*, *teratai kecil*, *ati-ati payau* (Malay).

English name. Blue waterlily.

Distribution. Africa, Asia to Australia; native in S and E Asia and W Malesia, where it is also frequently cultivated especially in temples. It is the national flower of Sri Lanka. In Peninsular Malaysia, it has a scattered distribution in many places being associated with settlements making it difficult to distinguish wild populations from those of cultivated origin.



Map 3. Distribution of wild populations of *Nymphaea nouchali*.

Conservation status. Least Concern (Assessed by C.L. Lim).

Ecology. In the lowlands, in ditches, margins of streams and formerly in paddy fields, in shallow, static or slow-flowing water (elsewhere growing in water 1–2 m deep). It is a recent introduction in Tasik Bera, Pahang (Rafidah *et al*., Malay. Nat. J. 62 (2010) 249). The day-blooming flowers are slightly fragrant expanding in the morning and closing at night. Cultivated

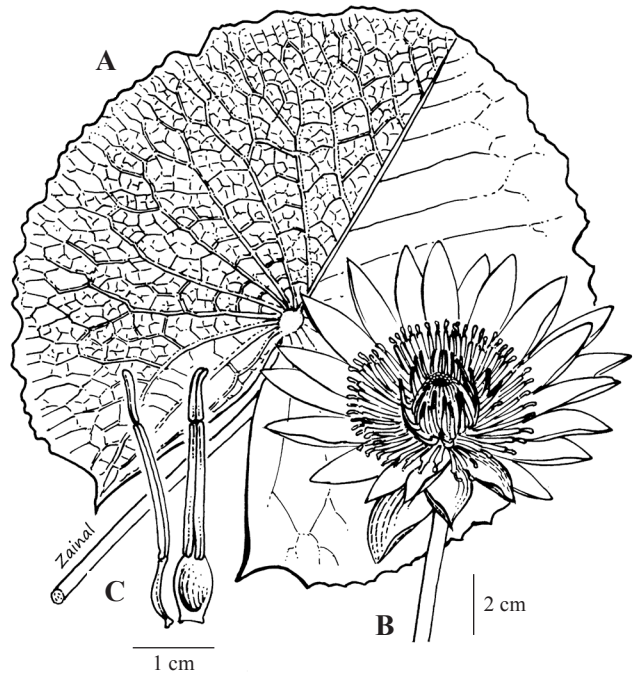


Figure 2. *Nymphaea nouchali*. A, leaf showing upper and lower lamina surface; B, open flower (top view); C, stamen. (side and adaxial view.)

plants attract *Trigona* bees in the morning suggesting bee pollination. The great range in flower size depends on edaphic factors, such as water depth and nutrient availability.

Uses. A common ornamental waterlily in Asia. Its small size enables it to be grown in tubs. In Sri Lanka the flower stalks are eaten as a vegetable, and the seeds eaten as puffed grain (Slocum, 2005), and the rhizomes are cultivated for starch and can yield up to 2500 kg/ha annually (Schmelzer, PROSEA 12, 2 (2001) 386).

Taxonomy. Plants with violet-blue flowers, which include those native in Peninsular Malaysia, have been named var. *cyanea* (Hook.*f.* & Thomson) Almeida while those with white or pink flowers as var. *versicolor* (Roxb.) Hook.*f.* & Thomson. However, since they differ only in flower colour, they are best treated as forms.

2. **Nymphaea pubescens** Willd. Map 4, Plate 49A–D

(Latin, *pubescens* = finely hairy, referring to the lower surface of the veins).

Sp. Pl. 2 (1799) 1154; Backer & Bakhuizen *f.*, Fl. Java 1 (1964) 148; Mitra Fl. India 1 (1993) 426; Keng, Order Fam. Malay. Seed Pl. (1983) fig. 20A; Slocum, Waterlilies and Lotuses (2005) 99. **Type:** East India (no specimen cited). (M, barcode M0171693). **Homotypic synonym:** *Nymphaea lotus* L. var.

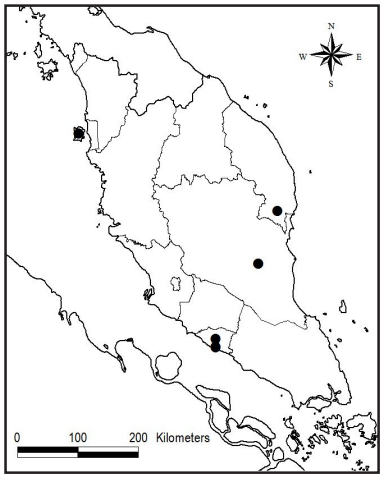
pubescens (Willd.) Hook. *f.* & Thom., Fl. Indica 1 (1855) 241; Hooker *f.*, Bot. Mag. t. 4665, Hooker *f.* & Thomson, Fl. Brit. India 1 (1872) 114; Ridley, Fl. Malay. Pen. 1 (1922) 116.

Leaves: petioles *pubescent,* greenish brown, to 200 cm long, 2–8 mm diameter; lamina elliptic to broadly elliptic to slightly peltate, green above, purplish beneath, 12–50 × 8–28 cm, base deeply cordate, sinus narrow, margin *coarsely dentate, teeth to 1–10 mm long and 6–22 mm apart;* midrib thick; lateral veins 5–8 pairs, prominent and *densely yellow or brown tomentose beneath*. **Flowers** held slightly above the water, opening 5–15 cm across; sepals 4, green, puberulous, elliptic, 30–45 × 13–25 mm, apex blunt; petals slightly shorter than sepals, *white*, sometimes tinged pink, 12–30, elliptic, 20–40 × 6–15 mm, apex obtuse; stamens yellow, 38–46, filaments narrowly triangular, outer stamens 35–40 mm long, inner ones 6–17 × 1–9 mm, anthers 5–15 mm long with a short appendage less 1 mm long; ovary with 13–16 locules, stigma yellow. **Berry** depressed globose, 20–37 mm long, 30–55 mm diameter. **Seeds** green, broadly ellipsoid, *c*. 1.5 × 1.3 mm.

Vernacular name. *Telipuk putih* (Malay).

English name. Night lotus.

Distribution. From Pakistan and Sri Lanka to China (Yunnan) and Taiwan, throughout Malesia to tropical NE Australia. It is the national flower of Bangladesh. In Peninsular Malaysia, it has been collected in Melaka, Penang and Terengganu, where the populations could be of cultivated origin, but it was collected in Tasik Chini, Sg. Pahang, in 1913 (*Burn-Murdoch 308*) suggesting that it is native there.



Map 4. Distribution of *Nymphaea pubescens.*

Conservation status. Least Concern (Assessed by C.L. Lim).

Ecology. Lowlands, in pools, ditches and lake margins with shallow, stagnant or slow flowing water. Its moderately sweetly scented flowers open in the evening and close before the following afternoon. The flowers last for 3 days. The pollinator is unknown but is possibly beetles.

Uses. Cultivated as an ornamental for its fragrant white flowers.

PLATES

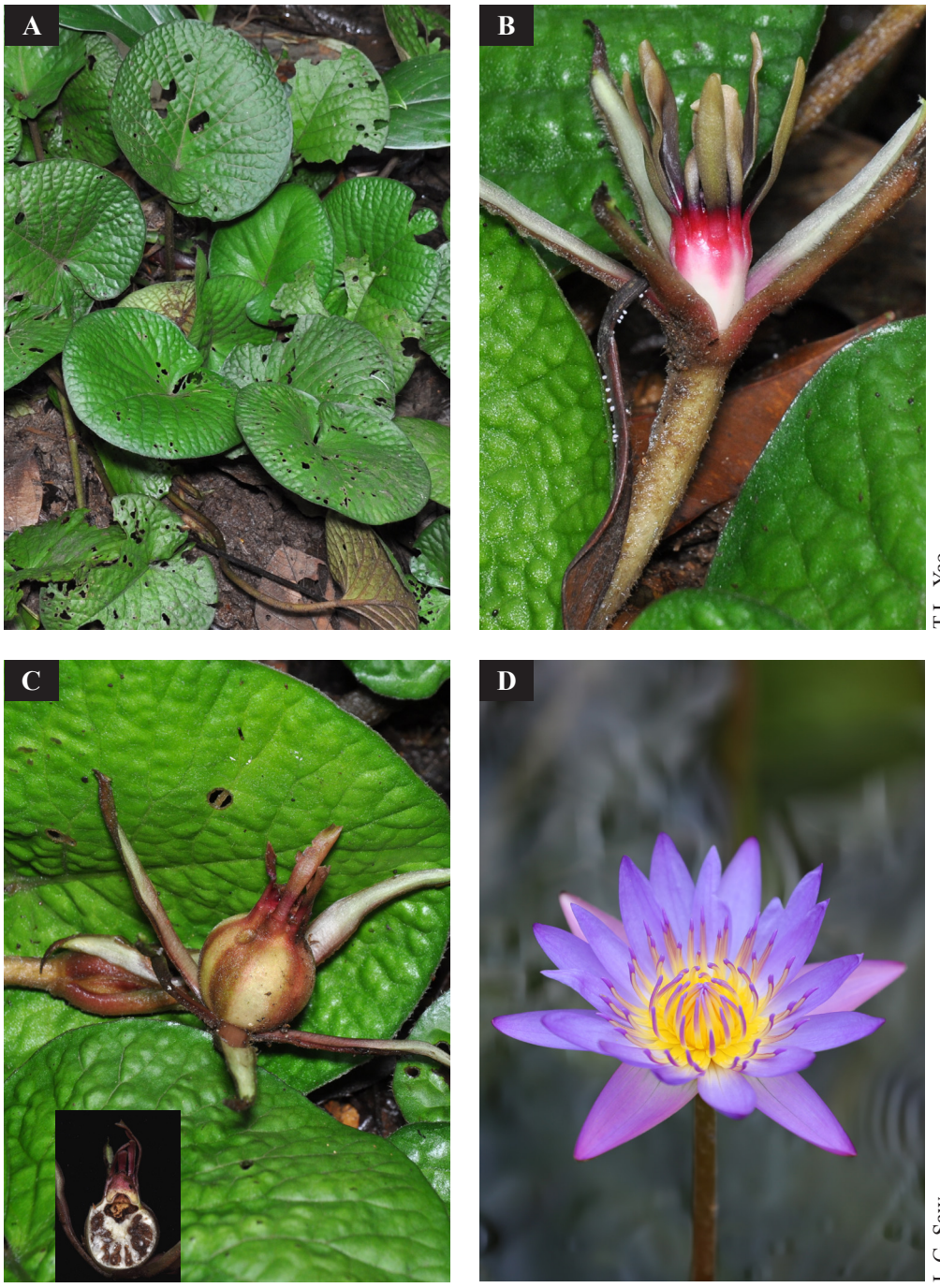


Plate 48. Nymphaeaceae. A–C, *Barclaya rotundifolia*; D, *Nymphaea nouchali*.

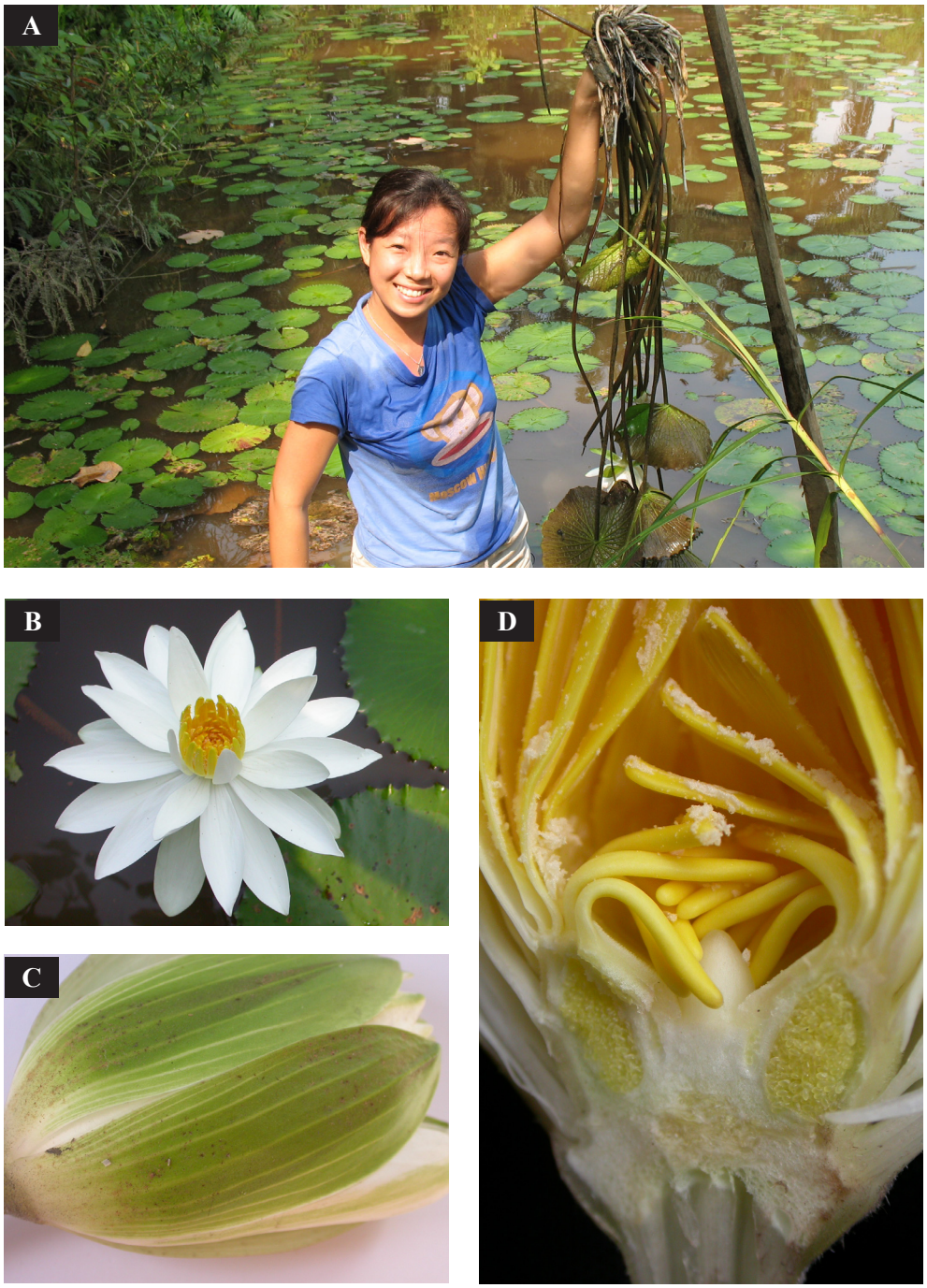
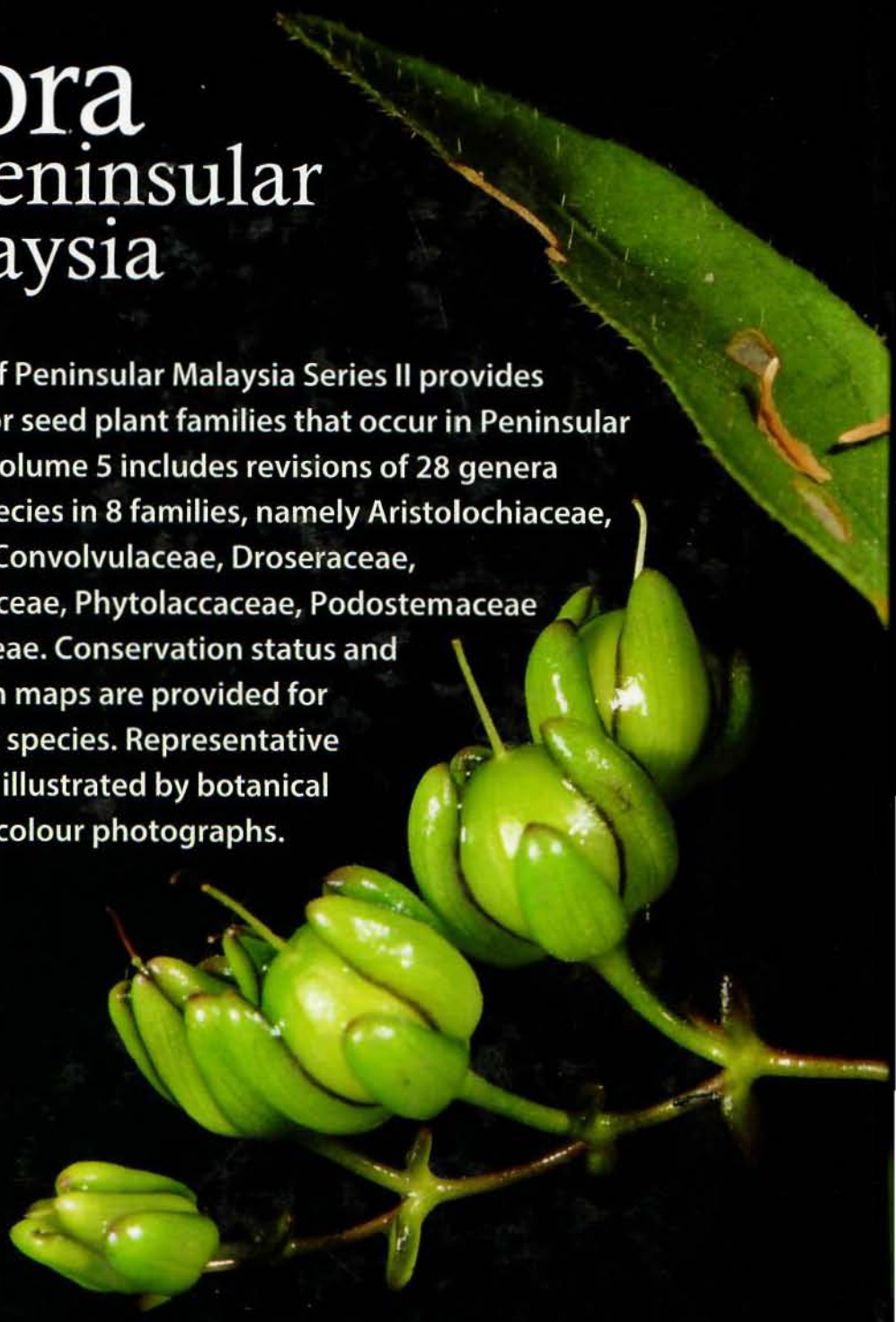


Plate 49. Nymphaeaceae. A–D, *Nymphaea pubescens*.

Flora of Peninsular Malaysia

The Flora of Peninsular Malaysia Series II provides revisions for seed plant families that occur in Peninsular Malaysia. Volume 5 includes revisions of 28 genera and 123 species in 8 families, namely Aristolochiaceae, Buxaceae, Convolvulaceae, Droseraceae, Nymphaeaceae, Phytolaccaceae, Podostemaceae and Viscaceae. Conservation status and distribution maps are provided for indigenous species. Representative species are illustrated by botanical plates and colour photographs.



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