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The Dipterocarpaceae of Hala-Bala Forest Complex, Narathiwat and Yala Provinces, Peninsular Thailand

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ABSTRACT. Seven genera, 43 species and one subspecies of the family Dipterocarpaceae were recorded from the Hala-Bala forest complex, Narathiwat and Yala provinces, Peninsular Thailand. Eleven species and one subspecies of dipterocarps are new records for Thailand. Identification keys to the genera and species of Dipterocarpaceae encountered in the Hala-Bala forest complex are also provided.

KEY WORDS: Dipterocarpaceae, dipterocarp, Hala-Bala forest, Thailand.

INTRODUCTION

Botanical surveys on species diversity of Dipterocarpaceae in the Hala-Bala forest complex in Narathiwat and Yala provinces, Peninsular Thailand were conducted extensively during 2004–2006 by the first author. The Hala-Bala forest complex which adjoins the northern border of Peninsular Malaysia to the south, comprises two major protected areas (Bang Lang National Park and Hala-Bala Wildlife Sanctuary) covering non-contiguous forest areas of about 618,750 rais or 990 square kilometers (Fig. 1). The Dipterocarps of Hala-Bala Forest are predominantly Malesian in their affinities as the forest is the northernmost part of the tropical evergreen rain forest of the Malesian region. Before the turn of the 21st Century, information and knowledge on the taxonomy, ecology and geography of Thai dipterocarps were rather sketchy. The Dipterocarpaceae of Thailand was first treated in Florae Siamensis Enumeratio by Craib (1925) who recorded 10 genera, 46 species and 7 varieties. Fewer than half of the treated dipterocarp species were recorded from the Hala-Bala forest complex. The most recent published checklist of Dipterocarpaceae in Thailand provided by Pooma & Newman (2001) recorded 8 genera, 63 species and 2 subspecies, of which 33 species were located in the Hala-Bala forest complex. The surveys conducted for the present study have so far resulted in 7 genera, 43 species and 1 subspecies for the Hala-Bala forest complex. It is noteworthy that two-thirds of the total number of dipterocarp species found in Thailand occur exclusively in this area. These dipterocarps are well established in moist evergreen rain forests mainly at low altitudes, of which only a few reach to a maximum of 1,200 m. Ecologically the evergreen dipterocarps of the Hala-Bala forest complex can be divided into three types, namely lowland evergreen dipterocarp forest (below 300 m), hill evergreen dipterocarp forest (300–800 m), and upper evergreen dipterocarp forest (800–1,200 m). Most species thrive in the lowland and hill evergreen dipterocarp forest types, mostly below 500 m altitude. Eleven species sporadically reach upper evergreen dipterocarp forest, for example: *Anisoptera curtisii*, *Dipterocarpus acutangulus*, *Parashorea stellata*, *Hopea montana*, *Shorea gratissima*, and *Vatica cuspidata* (Fig. 2).

DIPTEROCARPACEAE Blume

The family Dipterocarpaceae comprises 17 genera and 535 or more species worldwide. In Thailand, 63 species and 2 subspecies in 8 genera were previously recorded (Pooma & Newman 2001). Seven genera, 43 species and 1 subspecies have now been recorded in the Hala-Bala forest

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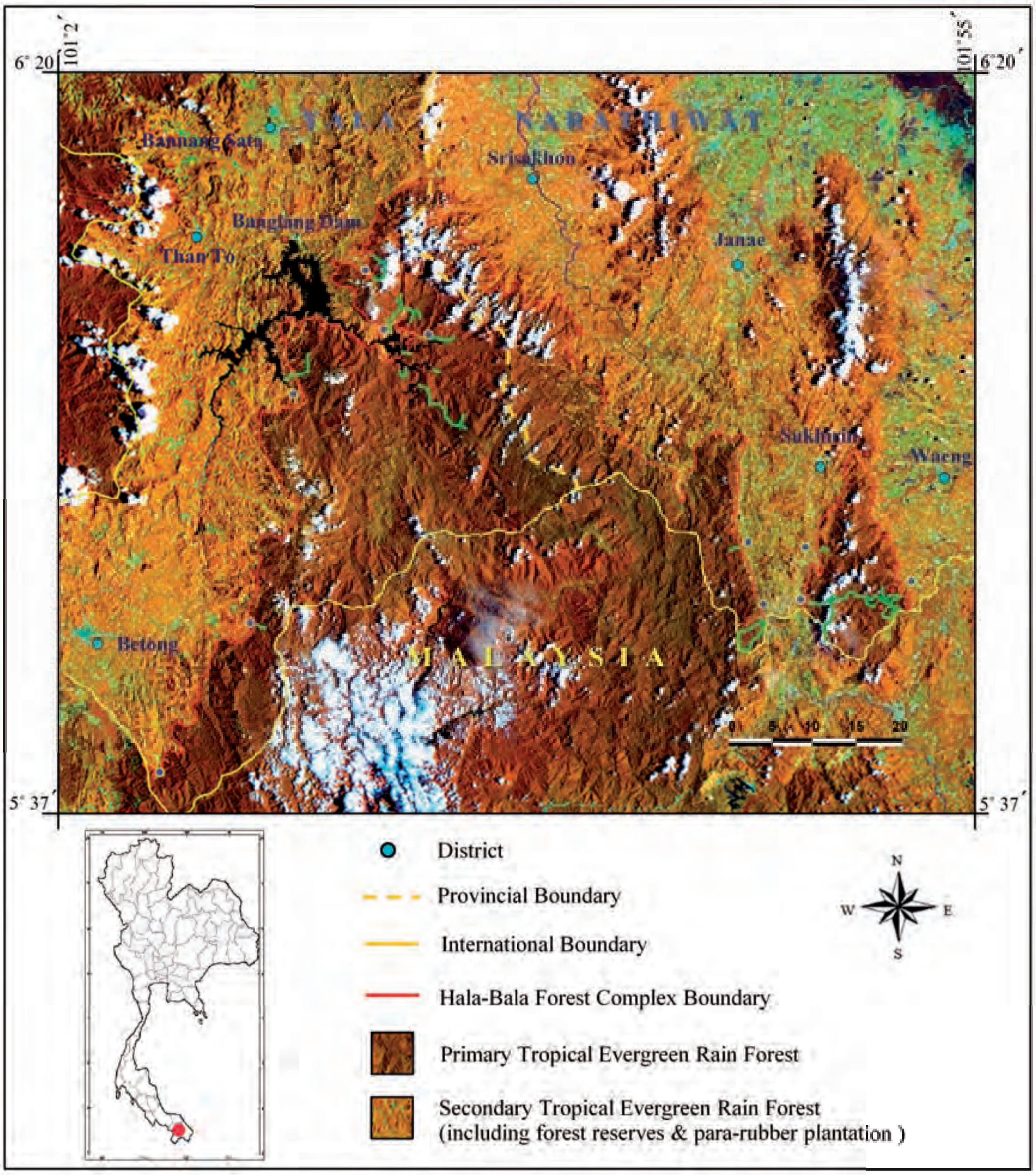

Figure 1. Satellite imagery (2001) of the Hala-Bala forest complex in Narathiwat-Yala provinces.

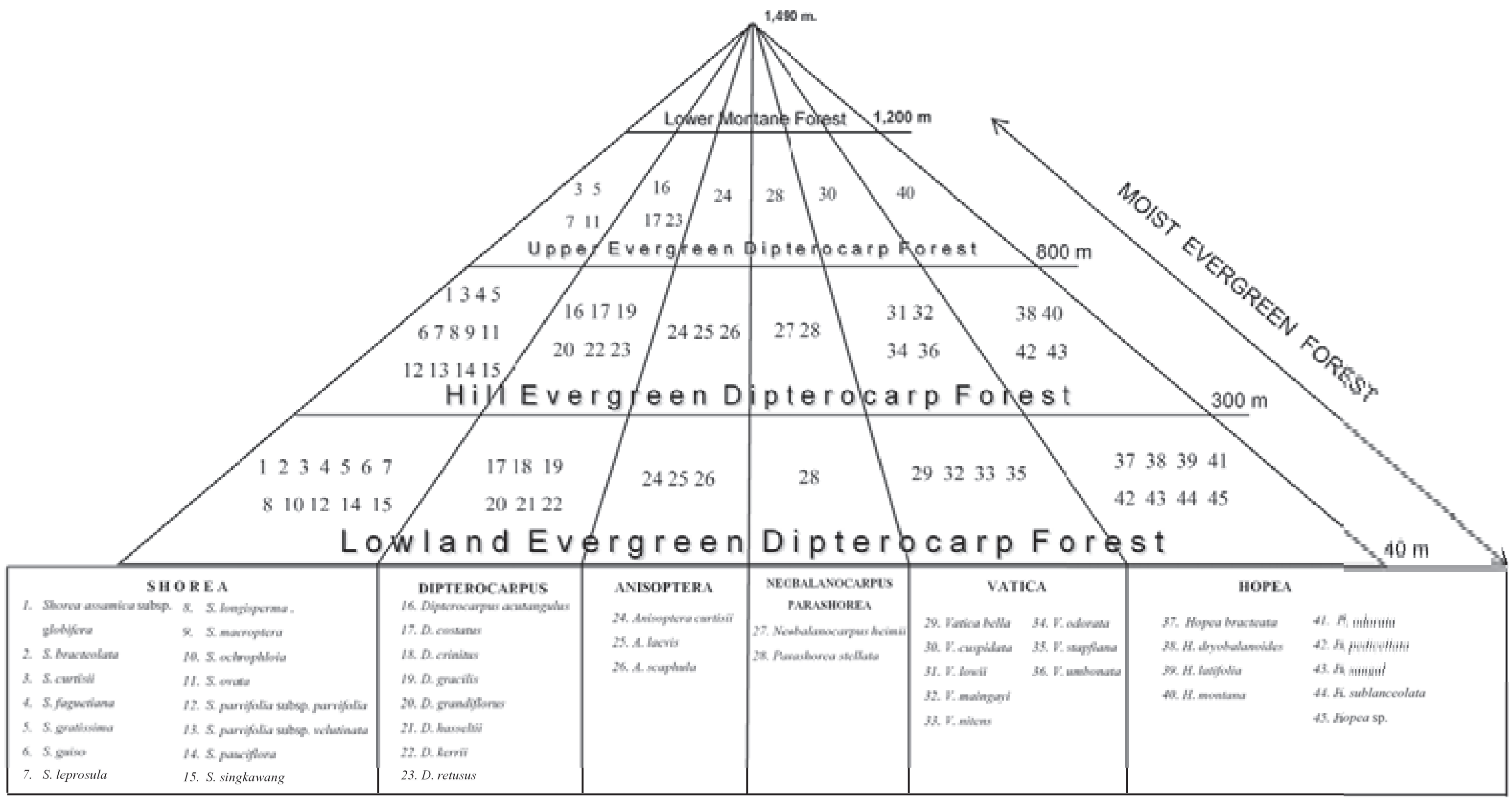

Figure 2. Ecological distribution of the evergreen dipterocarps in the Hala-Bala forest complex, Narathiwat and Yala provinces.

complex resulting in a total of 8 genera, 78 species and 1 subspecies of Dipterocarpaceae for Thailand. The only genus found in Thailand but not in Hala-Bala is *Cotylelobium*, represented by *C. lanceolatum* Craib. It is found in drier habitats of lowland, semi-evergreen or seasonal rain forest on old sand dunes along the eastern coast of Peninsular Thailand, a habitat type not found in the Hala-Bala forest complex.

KEY TO THE GENERA

1. Fruiting calyx lobes valvate, developed into unequal wings, or not developed. Ovary half to partly inferior
  2. Fruiting calyx lobes developed into 2 long and 3 short wings, partially united at base into a tube enclosing less than half of nut body, or not developed into wings; 2 long wings with 5–7 longitudinal veins. Inflorescence mostly thyrse. Stamens 15 **3**. **Vatica**
  2. Fruiting calyx lobes developed into 2 long wings and 3 much shorter wings or lobes, united at base forming a tube enclosing at least basal half of nut body; 2 long wings with 3 longitudinal veins. Inflorescence raceme or raceme-panicle. Stamens 15–30
    3. Fruiting calyx tube entirely adnate with nut body. Corolla not exceeding 1 cm in length, white or yellowish white. Leaf lateral veins joining, forming intramarginal veins; venation scalariform- reticulate **1**. **Anisoptera**
    3. Fruiting calyx tube partially adnate with nut body. Corolla longer than 2.5 cm in length, white, tinged with pink to orange stripes. Leaf lateral veins not forming intramarginal veins; venation scalariform **2**. **Dipterocarpus**
1. Fruiting calyx lobes imbricate, developed into subequal or very unequal wings, rarely not developed. Ovary superior
  4. Fruiting calyx lobes developed into 5 subequal wings much exceeding nut body, or into 5 suborbicular lobes not exceeding nut body
    5. Fruiting calyx lobes developed into 5 subequally long wings, contracted at base to slender stalks not enclosing nut body; nut ovoid, lenticellate. Anther and ovary puberulous **4**. **Parashorea**
    5. Fruiting calyx lobes developed into 5 coriaceous, suborbicular lobes enclosing less than half of nut body; nut ellipsoid to conical, smooth. Anther and ovary glabrous **5. Neobalanocarpus**
  4. Fruiting calyx lobes unequally developed, at base embracing nut body tightly or loosely
    6. Fruiting calyx lobes developed into 2 long wings and 3 short lobes, or not developed. Leaf lateral veins pinnate or dryobalanoid to subdryobalanoid-pinnate (Fig. 3); venation reticulate or scalariform **6**. **Hopea**
    6. Fruiting calyx lobes developed into 3 long and 2 short wings, rarely subequal, or not developed. Leaf lateral veins pinnate; venation obviously scalariform **7**. **Shorea**

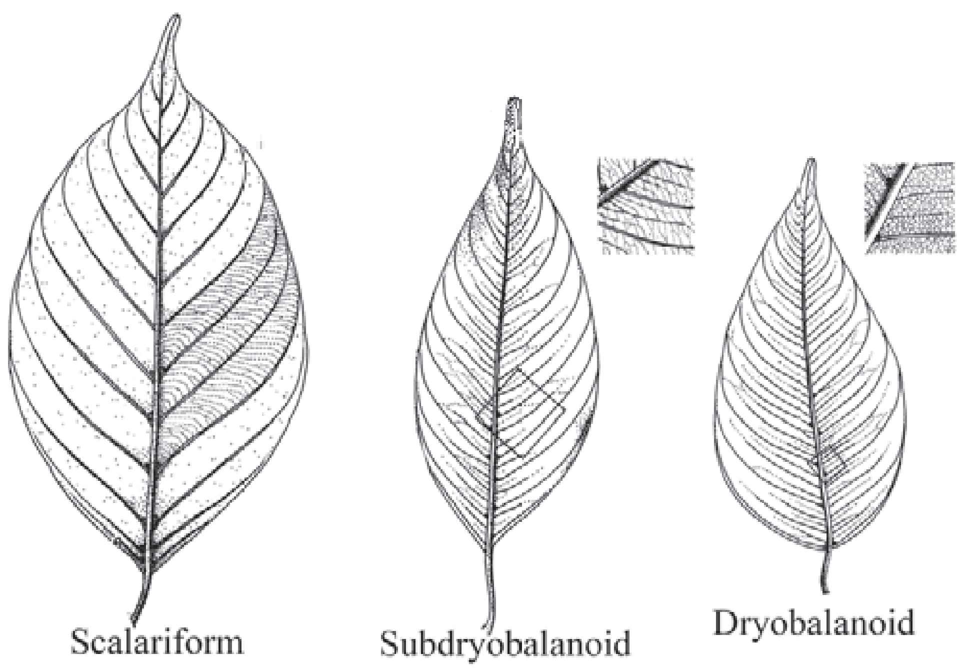

Figure 3. Leaf vanation types of *Hopea*.

1. ANISOPTERA

Korth., Verh. Nat. Gesch. Ned. Bezitt., Bot.: 65. 1841.— *Mocanera* Blanco, Fl. Filip., ed. 1: 446. 1837.— *Antherotriche* Turcz., Bull. Soc. Imp. Naturalistes Moscou 2: 505. 1846.- *Scaphula* R.Parker, Repert Spec. Nov. Regni Veg. 30: 326. 1932.— *Hopeoides* Cretz., J. Jap. Bot. 17(7): 408. 1941.

Eleven species are distributed from Bangladesh to Burma, Thailand, Indochina and Malesia. Four species are recorded for Thailand of which three species are in the Hala-Bala forest complex.

KEY TO THE SPECIES

1. Leaves bright golden lepidote and tomentose beneath. Flower bud long-obconical. Stamens 25; apical appendages filiform, much exceeding anthers. Stylopodium short-cylindric **1**. **A**. **curtisii**
1. Leaves rusty lepidote or glabrescent beneath. Flower bud ovoid. Stamens 15; apical appendages mucronate, much shorter than anthers. Stylopodium discoid
   2. Leaves rusty lepidote beneath; apex long-acuminate, 5–10 mm long; lateral veins 10–12(–14) per side; venation reticulate **2**. **A**. **laevis**
   2. Leaves glabrescent beneath; apex short-acuminate, 3–5 mm long; lateral veins (12–)15–18 per side; venation scalariform-reticulate **3**. **A**. **scaphula**

1. **Anisoptera curtisii** Dyer ex King, J. Asiat. Soc. Bengal, Pt. 2, Nat. Hist. 62: 100. 1893; Symington, Malayan Forest Rec. 16: 204, t. 98, f. 1. 1943; Smitinand, FAO-RAPA, Dipterocarps of South Asia: 39. 1985; Ashton, Fl. Mal. Ser. I, Spermatophyta 9: 329. 1982; Pooma & Newman, Thai For. Bull. (Bot.) 29: 115. 2001. Fig. 16.

Thailand.— PENINSULAR: Satun, Yala (Bannang Sata, Than To, Betong districts), Narathiwat (Sukhirin & Waeng districts).

Distribution.— Peninsular Malaysia, Sumatra. (Fig. 4).

Ecology.— Common, confined to ridges or hilltops in lowland and hill evergreen dipterocarp forest; alt. 150–850 m. Flowering: April. Fruiting: July.

Additional specimens.— *Poopath-A45*, 6 May 2004, Than To, Yala (**BKF**); *Poopath-A67*, 10 April 2005, Than To, Yala (**BKF**); *Poopath-A71*, 10 April 2005, Than To, Yala (**BKF**); *Poopath-A101*, 15 July 2005, Than To, Yala (**BKF**); *Poopath-B31*, 9 Sept. 2004, Sukhirin, Narathiwat (**BKF**); *Poopath -B123*, 12 July 2005, Sukhirin, Narathiwat (**BKF**).

2. **Anisoptera laevis** Ridl., Fl. Mal. Pen. 1: 219. 1922; Symington, Malayan Forest Rec. 16: 205, t. 96, 97, 98, f. 2. 1943; Ashton, Fl. Mal. Ser. I, Spermatophyta 9: 335. 1982.— *A. glabra* auct. non Kurz: Ridl., Agric. Bull. Straits Fed. Malay States. 1: 60. 1901.— *A. thurifera* auct. non Blume: Foxw., Philipp. J. Sci., C. 6: 257, p.p. 1911.— *A. mindanensis* auct. non Foxw.: Wyatt-Sm., Malayan Forest Rec. 18: 77, p.p. 1955. Figs. 16, 21A.

Thailand.— PENINSULAR: Narathiwat (Sukhirin & Waeng districts).

Distribution.— Peninsular Malaysia, Sumatra, Borneo (Brunei, Sarawak, Sabah). (Fig. 4).

Ecology.— Rare, sporadically found on well-drained, undulating to ridged terrains in lowland and hill dipterocarp forest; alt. 150–550 m. Flowering: May–June. Fruiting: October.

Additional specimens.— *Poopath-B126*, 28 Oct. 2005, Waeng, Narathiwat (**BKF**); *Poopath-B50*, 24 July 2004, Waeng, Narathiwat (**BKF**); *Poopath-B122*, 12 July 2005, Sukhirin, Narathiwat (**BKF**); *Poopath-B125*, 10 Aug. 2005, Sukhirin, Narathiwat (**BKF**).

3. **Anisoptera scaphula** (Roxb.) Kurz., Bull. Jard. Bot. Buitenzorg III, 9: 102, f. 6. 1927; Symington, Malayan Forest Rec. 16: 218, t. 104, f. 2. 1943; Ashton, Fl. Mal. Ser. I, Spermatophyta 9: 352. 1982; Pooma & Newman, Thai For. Bull. (Bot.) 29: 115, f. 1. 2001. Fig. 16.

Thailand.— NORTHERN: Tak (Taksin National Park: Kra bak yai); SOUTH-WESTERN: Kanchanaburi; PENINSULAR: Chumphon (Lang Suan), Ranong (Kapoe, Kam Phuan), Surat Thani (Na San), Phangnga (Takua Pa), Krabi (Ao Luek, Khao Phanom), Nakhon Si Thammarat (Chawang), Yala

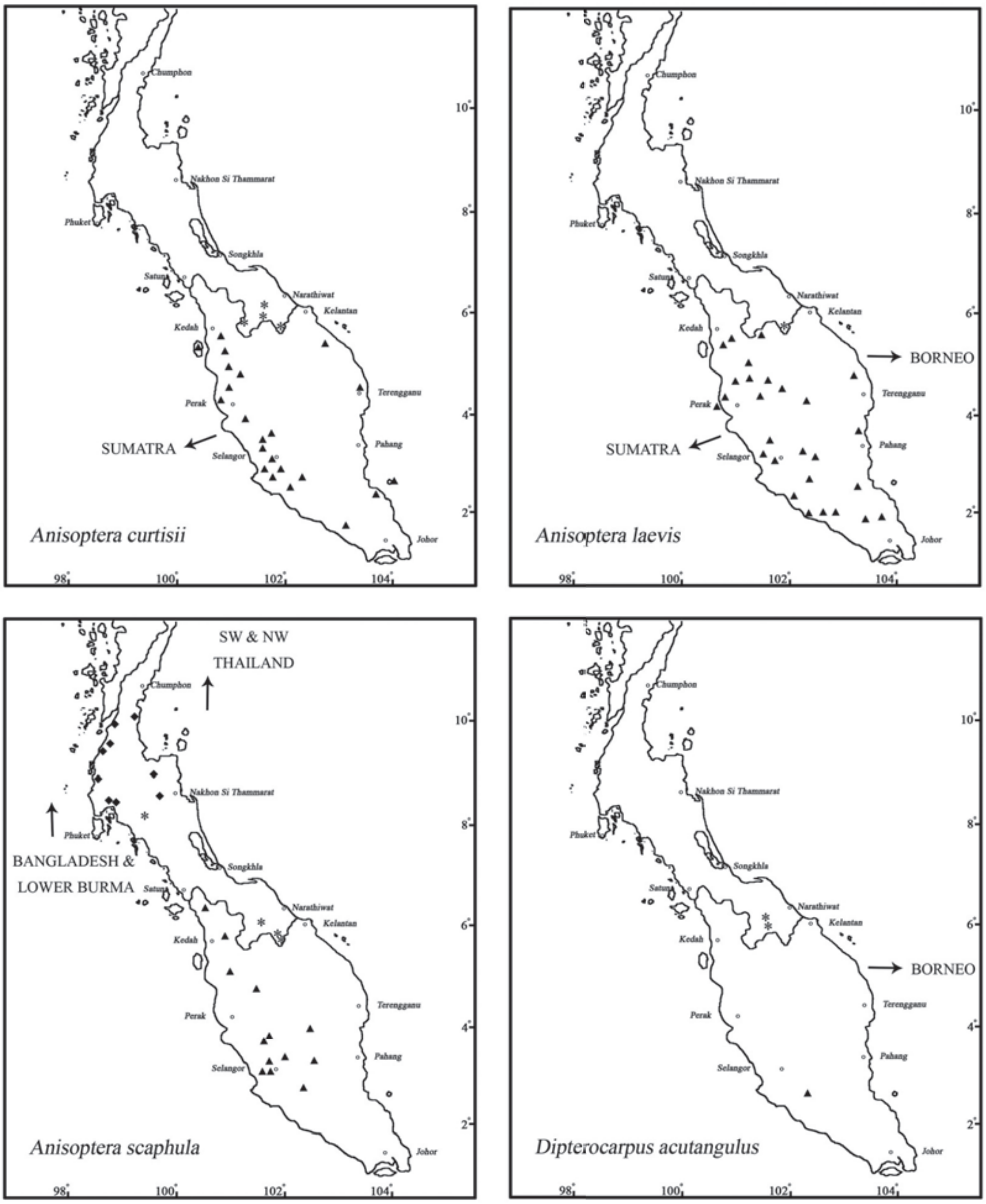

Figure 4. Distribution maps of *Anisoptera curtisii*, *A. laevis*, *A. scaphula* and *Dipterocarpus acutangulus* in Peninsular Thailand-Malaysia (♦ Pooma (2003), ▲ Symington (1943) and * Authors)

(Betong & Than To districts), Narathiwat (Sukhirin & Waeng districts).

Distribution.— Bangladesh (Chittagong), Lower Burma, Peninsular Malaysia. (Fig. 4).

Ecology.— Rare, sporadically found along stream courses on undulating to ridged terrains in lowland and hill evergreen dipterocarp forest; alt. 100–650 m. Flowering: March–April. Fruiting: May.

Additional specimens.— *Poopath-A80*, 22 May. 2005, Betong, Yala (**BKF**); *Poopath-A90*, 25 May. 2005, Betong, Yala (**BKF**); *Poopath-B137*, 26 Aug. 2006, Waeng, Narathiwat (**BKF**).

Note.— Although already previously known from Thailand the locality records for Narathiwat and Yala provinces are new.

2. DIPTEROCARPUS

C.F.Gaertn., Suppl. Carp.: 500. 1805.— *Oleoxylon* Roxb., Trans. Soc. London Encour. Arts 23: 413. 1805.— *Mocanera* Blanco, Fl. Filip., ed. 1: 446. 1837.— *Pterygium* Corrêa, Gen.: Pl. 1013. 1840.— *Duvaliella* F.Heim, Bull. Mens. Soc. Linn. Paris 2(127): 1011. 1892.

The genus *Dipterocarpus* consists of about 70 species, distributed from Sri Lanka, India, S. China, Burma, Indochina and Malesia. Sixteen species are recorded for Thailand of which eight species are in the Hala-Bala forest complex.

Key to the species

1. Fruiting calyx tube longitudinally and narrowly winged or angled
  2. Fruiting calyx broadly ellipsoid, 4–8 cm long, with 5 straight to slightly undulate and narrow wings exceeding 5 mm in width; 2 large apical wings 15–20 cm long, 3–4 cm broad. Leaves usually 15–24 cm long; petioles 5–8 cm long **5. D. grandiflorus**
  2. Fruiting calyx tube ovoid or subglobose, less than 3 cm long, with 5 straight and narrow wings or angles less than 5 mm broad; 2 large apical wings less than 15 cm long. Leaves usually 6–14 cm long; petioles less than 3.5 cm long
    3. Fruiting calyx tube ovoid, 2.7–3.2 cm long, glabrous; 2 large apical wings 10–14 cm long, 2.5–3.5 cm broad. Leaves sparsely puberulous to glabrous beneath **1. D. acutangulus**
    3. Fruiting calyx tube subglobose, 1.5–2 cm long, pubescent; 2 large apical wings 6–9 cm long, 1.8–2 cm broad. Leaves densely tufted hairy beneath **2. D. costatus**
1. Fruiting calyx tube smooth, never angled
  4. Stipules densely villous inside, glabrous outside. Young twigs glabrous. Leaves glabrous on both surfaces. Fruiting calyx tube glabrous; 2 large apical wings slightly revolute at bases; 3 short lobes prominently revolute **7. D. kerrii**
  4. Stipules glabrous inside, tomentose to pubescent outside. Young twigs more or less hairy, or glabrous. Leaves more or less hairy or glabrous on both surfaces, or glabrous above, sparsely hairy beneath. Fruiting calyx tube pubescent to glabrous; 2 large and 3 short apical wings revolute or not at bases
    5. Young twigs with tufted long hairs, hairs 3-4 mm long. Leaves densely tufted long hairy on both surfaces. Fruiting calyx tube ellipsoid; 2 long apical wings 7–9 cm long **3. D. crinitus**
    5. Young twigs sparsely hairy or glabrous, hairs less than 2 mm long. Leaves subglabrous to glabrous on both sides, or tomentose hairy beneath. Fruiting calyx tube ovoid or subglobose; 2 long apical wings more than 11 cm long
      6. Young twigs tomentose. Leaves tomentose beneath. Fruiting calyx tube ovoid; 2 long apical wings 11–17 cm long; 3 short lobes slightly exceeding half the length of calyx tube **4. D. gracilis**
      6. Young twigs glabrous to subglabrous. Leaves glabrous or sparsely hairy beneath. Fruiting calyx tube subglobose; 3 short lobes less than half the length of calyx tube
        7. Leaves glabrous on both surfaces, or pubescent along midribs and main veins beneath; lateral veins 15–21 per side; apex bluntly acuminate; petioles tomentose to pubescent. Fruiting calyx wings 16–23 cm long, 2.5–4.2 cm broad **8. D. retusus**
        7. Leaves glabrous, shiny above, puberulous except glabrous midribs and main veins beneath; lateral veins 9–14 per side; apex acute-mucronate; petioles glabrous. Fruiting calyx wings 13–18 cm long, 2–2.8 cm broad **6. D. hasseltii**

1. Dipterocarpus acutangulus Vesque, Compt. Rend. Hebd. Séances Acad. Sci. 78: 626. 1874; J. Bot. 12: 150. 1874; Symington, Malayan Forest Rec.16: 166, t. 76, fig. 2. 1943; Ashton, Fl. Mal. Ser. I, Spermatophyta 9: 322. 1982.— *D. appendiculatus* Dyer, J. Bot. 12: 152. 1874, non Scheff. 1870.— *D. tawaensis* Slooten, Bull. Jard. Bot. Buitenzorg. III (8): 313, f. 6. 1927.— *D. helicopteryx* Slooten, Bull. Jard. Bot. Buitenzorg III (16): 441, f. 4. 1940. Figs. 16, 21B.

Thailand.— PENINSULAR: Yala (Bannang Sata & Betong districts).

Distribution.— Peninsular Malaysia, Borneo (Brunei, Kalimantan, Sabah, Sarawak). (Fig. 4).

Ecology.— Very rare, sporadic on high ridges and hilltops in hill and upper evergreen dipterocarp forests; alt. 600–1,050 m. Flowering: April. Fruiting: July–August.

Additional specimens.— *Poopath-A32*, 15 July 2004, Bannang sata, Yala (**BKF**); *Poopath-A64*, 20 Oct. 2004, Bannang Sata, Yala (**BKF**); *Poopath-A65*, 9 April 2005, Bannang sata, Yala (**BKF**); *Poopath-A83*, 22 May 2005, Betong, Yala (**BKF**).

2. **Dipterocarpus costatus** C.F.Gaertn., Suppl. Carp.: 50, t. 187. 1805; Symington, Malayan Forest Rec. 16: 173, t. 81, f. 1. 1943; Smitinand, Thai For. Bull. (Bot.) 12: 33. 1980; Ashton, Fl Mal. I, 9: 321. 1982; Pooma & Newman, Thai For. Bull. (Bot.) 29: 124. 2001.— *D. insularis* Hance, J. Bot. 14: 241. 1876.— *D. artocarpifolius* Pierre, Fl. Forest. Cochinch., t. 213. 1889.— *D. parvifolius* F.Heim, Bot. Tidsskr. 25: 43. 1903. Fig. 16.

Thailand.— NORTHERN: Chiang Mai, Lampang, Phrae, Tak, Sukhothai; NORTH-EASTERN: Phetchabun, Nong Khai, Nakhon Phanom; EASTERN: Nakhon Ratchasima, Ubon Ratchathani; SOUTH-WESTERN: Kanchanaburi; CENTRAL: Nakhon Nayok; SOUTH-EASTERN: Sa Kaeo, Trat; PENINSULAR: Chumphon, Ranong, Surat Thani, Phangnga, Phuket, Krabi, Nakhon Si Thammarat, Trang, Satun, Yala (Bannang Sata, Than To, Betong districts), Narathiwat (Ba Choh, Waeng, Sukhirin districts).

Distribution.— Bangladesh, Burma, Andaman & Nicobar Islands, Laos, S. Vietnam, Cambodia, Peninsular Malaysia. (Fig. 5).

Ecology.— Common often gregarious on ridges and hilltops in lowland and hill evergreen dipterocarp forests; alt. 250–850 m. Flowering: Febuary–March. Fruiting: May–June.

Additional specimens.— *Poopath-A36*, 18 July 2004, Than To, Yala (**BKF**); *Poopath-A1*, 20 March 2005, Than To, Yala (**BKF**); *Poopath-A68*,10 April 2005, Than To, Yala (**BKF**); *Poopath-A74*, 17 May 2005, Than To, Yala (**BKF**).

3. **Dipterocarpus crinitus** Dyer in Hook.f., Fl. Brit. Ind. 1(2): 296. 1874; Symington, Malayan Forest Rec. 16: 175, t. 82, f. 1. 1943; Smitinand, Thai For. Bull. (Bot.) 12: 34. 1980; Ashton, Fl. Mal. Ser. I, Spermatophyta 9: 299. 1982; Pooma & Newman, Thai For. Bull. (Bot.) 29: 126. 2001.— *D. hirtus* Vesque, Compt. Rend. Hebd. Séancea Acad. Sci. 78: 627. 1874.— *D. tampurau* auct. non Korth: Burck, Ann. Jard. Bot. Buitenzorg 6: 198. 1887. Figs. 16, 21C–D.

Thailand.— PENINSULAR: Narathiwat (restricted to the border area in Waeng district of Narathiwat and Kelantan, Malaysia).

Distribution.— Peninsular Malaysia, Sumatra and Borneo. (Fig. 5).

Ecology.— Very rare, gregarious on undulating areas and low hills in lowland evergreen dipterocarp forest; alt. ca. 100 m. Fruiting: July–August.

Additional specimen.— *Poopath-B134*, 23 Aug. 2006, Waeng, Narathiwat (**BKF**).

Note.— A newly recorded species for Thailand, *Dipterocarpus crinitus* can be distinguished by its thick undulating leaves with very long and dense fuscicle hairs and its ellipsoidal fruit. The species was previously recorded for Thailand from Pattani by Foxworthy (1932) and further cited as such by Symington (1943), Smithinand et al. (1980) and Ashton (1982). Pooma & Newman (2001) reported that there were no specimens of this species to be found in AAU, BK, BKF, C, CMU, E, K and PSU. Later on, Pooma (2003) deleted *D. crinitus* as a species for Thailand because of this ambiguity. This study is the first confirmed record of *D. crinitus* for Thailand with a distribution limited to Hala-Bala forest.

4. **Dipterocarpus gracilis** Blume, Bijdr. Fl. Ned. Ind.: 224. 1825; Symington, Malayan Forest Rec. 16: 177, t. 83, f. 2. 1943; Smitinand, Thai For. Bull. (Bot.) 12: 35.1980; Ashton, Fl. Mal. Ser. I, Spermatophytes 9: 301. 1982; Pooma & Newman, Thai For. Bull. (Bot.) 29: 127. 2001.— *D. pilosus* Roxb., Fl. Ind. ed. 1832: 615. 1832.— *D. skinneri* King, J. Asiat. Soc. Bengal, Pt. 2, Nat. Hist. 62(2): 91. 1893; Craib, Fl. Siam. 1:137. 1925.— *D. turbinatus* var. *andamanicus* King, J. Asiat. Soc. Bengal, Pt. 2, Nat. Hist. 62(2): 92. 1893.— *D. schmidtii* F.Heim, Bot. Tidsskr. 25: 42. 1903; Craib, Fl. Siam. 1: 137. 1925.— *D. angustialatus* F.Heim, Bot. Tidsskr. 25: 43. 1903; Craib, Fl. Siam. 1: 133.

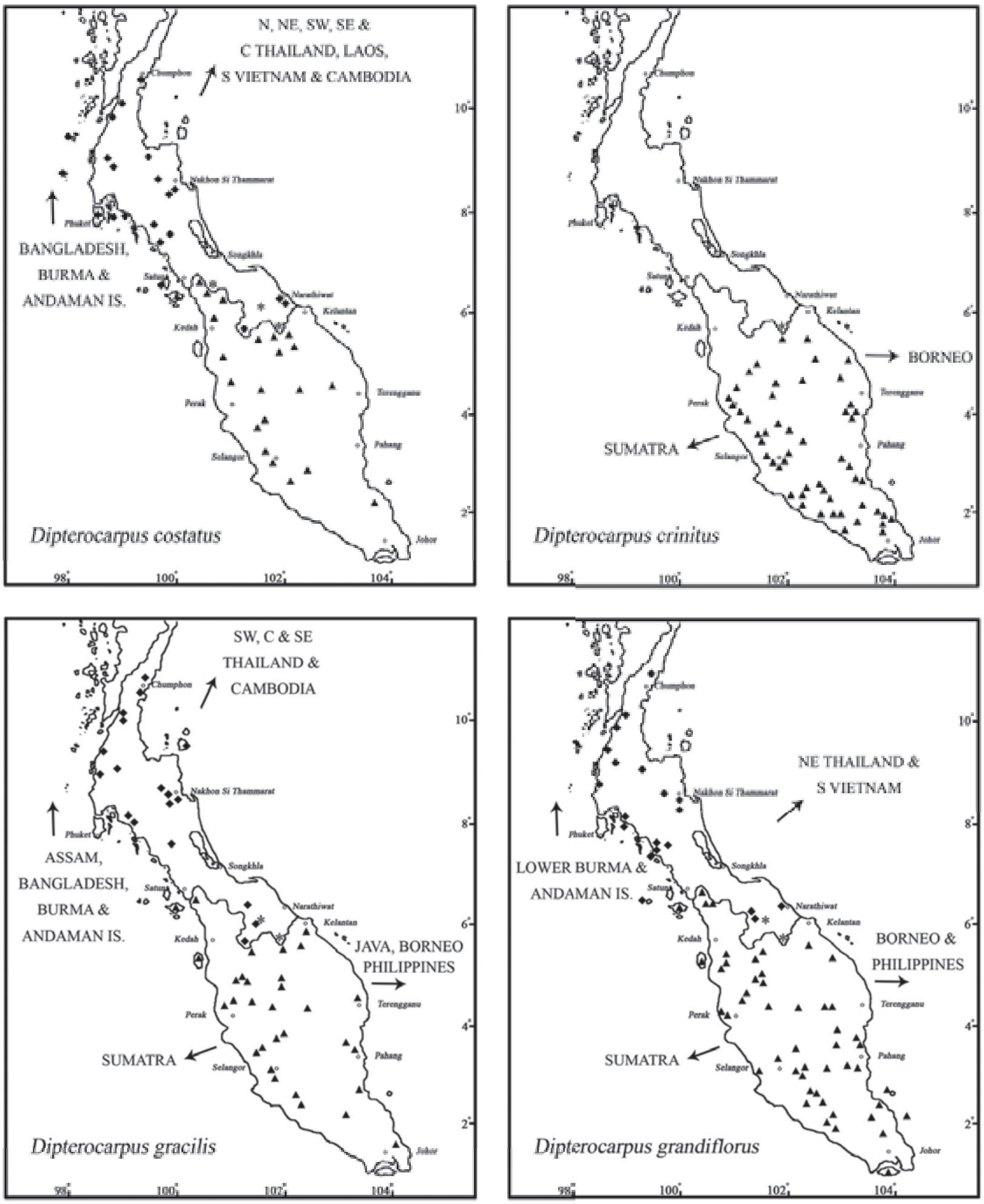

Figure 5. Distribution maps of *Dipterocarpus costatus*, *D. crinitus*, *D. gracilis* and *D. grandiflorus* in Peninsular Thailand-Malaysia (♦ Pooma (2003), ▲ Symington (1943) and * Authors)

1925.— *D. andamanicus* (King) Tewary & A.K.Sarkar, Proc. 3rd Round-table Conf. Dipterocarpaceae: 542. 1987. Fig. 16.

Thailand.— EASTERN: Nakhon Ratchasima; SOUTH-WESTERN: Kanchanaburi, Prachuap Khiri Khan; CENTRAL: Nakhon Nayok; SOUTH-EASTERN: Rayong, Trat; PENINSULAR: Chumphon, Ranong, Surat Thani, Phangnga, Nakhon Si Thammarat, Trang, Satun, Yala (Bannang Sata, Than To, Betong districts), Narathiwat (Waeng & Sukhirin districts).

Distribution.— India (Assam), Bangladesh, Burma, Andaman & Nicobar Islands, Peninsular

Malaysia, Singapore, Borneo (Kalimantan, Sabah), Java, Philippines. (Fig. 5).

Ecology.— Common, scattered on undulating to ridged terrains or along stream courses in lowland and hill evergreen dipterocarp forests; altitude up to ca. 600 m. Flowering: January–April. Fruiting: July–August.

Additional specimens.— *Poopath-B1*, 30 April 2004, Waeng, Narathiwat (**BKF**); *Poopath-B38*, 22 July 2004, Waeng, Narathiwat (**BKF**); *Poopath -B42*, 22 July 2004, Waeng, Narathiwat (**BKF**).

5. **Dipterocarpus grandiflorus** (Blanco) Blanco, Fl. Filip., ed. 2: 314. 1845; Ridl., Fl. Mal. Pen. 1: 216. 1922; Symington, Malayan Forest Rec. 16: 178, t. 84, f. 1.1943; Smitinand, Thai For. Bull. (Bot.) 12: 36. 1980; Ashton, Fl. Mal. Ser. I, Spermatophyta 9: 317. 1982; Pooma & Newman, Thai For. Bull. (Bot.) 29: 128. 2001.— *Mocanera grandiflora* Blanco, Fl. Filip. ed. 1: 451. 1837.— *Dipterocarpus griffithii* Miq., Ann. Mus. Bot. Lugd.-Bat. 1: 213. 1864.— *D. pterygocalyx* Scheff., Natuurk. Tijdschr. Ned. Ind. 31: 347. 1870. Fig. 16.

Thailand.— NORTH-EASTERN: Nong Khai (Bueng Kan), Nakhon Phanom (Phu Langka); PENINSULAR: Chumphon (Ban Map Ammarit), Ranong (Lam Liang), Surat Thani (Ban Bang Bao, Ratchaprapha Dam), Phangnga (Ko Surin), Phuket (Ko Pu), Nakhon Si Thammarat (Ron Phibun, Chawang), Trang (Khao Chong, Kantang, Talibong, Ko Libong), Satun (Ko Adang), Yala (Bannang Sata), Narathiwat (Waeng & Muang districts).

Distribution.— Lower Burma, Andaman & Nicobar Islands, Southern Vietnam, Peninsular Malaysia, Singapore, Borneo (Kalimantan), Sumatra, Philippines. (Fig. 5).

Ecology.— Very common, scattered or gregariously found on hill slopes and ridges in lowland and hill evergreen dipterocarp forests; alt. 50–500 m. Flowering: April. Fruiting: May-June.

Additional specimens.— *Poopath-B86*, 3 April 2005, Waeng, Narathiwat (**BKF**); *Poopath-B100*, 14 May 2005, Waeng, Narathiwat (**BKF**).

6. **Dipterocarpus hasseltii** Blume., Fl. Javae 2: 22. 1829; Craib, Fl. Siam. 1: 135. 1925; Symington, Malayan Forest Rec. 16: 180, t. 84, f. 2. 1943; Smitinand, Thai For. Bull. (Bot.) 12: 37. 1980; Ashton, Fl. Mal. Ser. I, Spermatophyta 9: 306. 1982; Pooma & Newman, Thai For. Bull. (Bot.) 29: 129. 2001.— *D. kerrii* auct. non King: Tardieu-Blot, Fl. Indo-Chine, Suppl. 1(3): 336, f. 33. 1943. Fig. 16.

Thailand.— SOUTH-WESTERN: Ratchaburi, Kanchanaburi; SOUTH-EASTERN: Trat; PENINSULAR: Ranong, Phangnga, Nakhon Si Thammarat, Yala (Bannang Sata, Than To districts), Narathiwat (Sukhirin).

Distribution.— Andaman & Nicobar Islands, Southern Vietnam, Peninsular Malaysia, Borneo, Sumatra, Java, Philippines. (Fig. 6).

Ecology.— Rare, sporadically found near streams in hilly areas in lowland evergreen dipterocarp forest; alt. 150–250 m. Flowering: April–May. Fruiting: July–August.

Additional specimens.— *Poopath-A7*, 5 May 2004, Than To, Yala (**BKF**); *Poopath-A69*, 10 April 2005, Than To, Yala (**BKF**); *Poopath-A60*, 6 Aug. 2004, Than To, Yala (**BKF**).

7. **Dipterocarpus kerrii** King, J. Asiat. Soc. Bengal, Pt. 2, Nat. Hist. 62(2): 93. 1893; Ridl., Fl.Mal. Pen. 1: 215. 1922; Craib, Fl. Siam. 1: 136.1925; Symington, Malayan Forest Rec.16: 181, t. 85, f. 1. 1943; Smitinand, Thai For. Bull. (Bot.) 12: 38. 1980; Ashton, Fl. Mal. Ser. I, Spermatophyta 9: 305. 1982; Pooma & Newman, Thai For. Bull. (Bot.) 29: 131, f. 3. 2001.— *D. obconicus* Foxw., Leafl. Philipp. Bot. 6: 1951. 1913.— *D. cuneatus* Foxw., Philipp. J. Sci., C 13 (3): 178. 1918.— *D. perturbinatus* Foxw., Philipp. J. Sci., C 13(3): 177. 1918. Fig. 17.

Thailand.— SOUTH-WESTERN: Ratchaburi; PENINSULAR: Ranong, Surat Thani, Phangnga, Phuket, Krabi, Nakhon Si Thammarat, Phatthalung, Trang, Satun, Songkhla, Yala (Bannang Sata, Than To, Betong districts).

Distribution.— Burma, Andaman & Nicobar Islands, Peninsular Malaysia, Singapore, Borneo (Brunei, Sabah, Sarawak), Philippines. (Fig. 6).

Ecology.— Common, often gregarious along stream courses, on hilly terrains in lowland evergreen dipterocarp forest; altitude up to ca. 500 m. altitude. Flowering: December-February. Fruiting: July.

Additional specimen.— *Poopath-A26*, 13 June 2004, Banglang Dam, Mae Wad, Than To, Yala (**BKF**).

8. **Dipterocarpus retusus** Blume, Catalog.: 77. 1823; Symington, Malayan Forest Rec. 16: 186, t. 89, f. 1. 1943; Smitinand, Thai For. Bull. (Bot.) 12: 40. 1980; Ashton, Fl. Mal. Ser. I, Spermatophyta 9: 308. 1982; Pooma & Newman, Thai For. Bull. (Bot.) 29: 136. 2001.— *D. macrocarpus* Vesque, Compt. Rend. Hebd. Seances Acad. Sci. 78: 627. 1874.— *D. tonkinensis* A.Chev., Bull. Econ. Indoch. 4: 43. 1927. Fig. 17.

Thailand.— NORTHERN: Chiang Rai, Tak; EASTERN: Nakhon Ratchasima; SOUTH-WESTERN: Kanchanaburi; SOUTH-EASTERN: Chanthaburi; PENINSULAR: Phangnga, Krabi, Narathiwat (Sukhirin).

Distribution.— India (Assam), Burma, Laos, Cambodia, Vietnam, Southern China, Peninsular Malaysia, Sumatra, Java, Lesser Sunda Islands. (Fig. 6).

Ecology.— Rare, gregarious on high ridges and hilltops in hill evergreen dipterocarp forest; alt. 700–900 m. Flowering: May–July. Fruiting: October–November.

Additional specimens.— *Poopath-B18*, 2 May 2004, Sukhirin, Narathiwat (**BKF**); *Poopath-B20*, 24 Oct. 2003, Sukhirin, Narathiwat (**BKF**); *Poopath-B74*, 15 Oct. 2004, Sukhirin, Narathiwat (**BKF**).

Note.— A new locality recorded from Sukhirin district of Narathiwat.

3. VATICA

L., Mant. Pl. 2: 152. 1771.— *Retinodendron* Korth, Verh. Nat. Gesch. Ned. Bezitt., Bot. 55. 1841.— *Pteranthera* Blume, Mus. Bot. 2: 30. 1852.— *Retinodendropsis* F.Heim, C.R. Assoc. Fr. Pau. 1892: 470. 1893.— *Pachynocarpus* Hook.f., Trans. Linn. Soc. 23: 159, pl. 22. 1860.— *Elaeogene* Miq., Fl. Ned. Ind., Eerste bijv. 460. 1861.— *Synaptea* Kurz, J. Asiat. Soc. Bengal, Pt. 2, Nat. Hist. 39(2): 65. 1870.

The genus *Vatica* consists of 71 species, distributed from Sri Lanka, India to Burma, Hainan, Indochina and Malesia. Thirteen species are recorded for Thailand of which eight species are in the Hala-Bala forest complex.

KEY TO THE SPECIES

1. Fruiting calyx developed into 5 subequal, long wings, or 5 very thick lobes forming a woody cup tightly enclosing nut body
  2. Fruiting calyx developed into 5 reflexed, broadly ovate-elliptic wings, slightly exceeding the length of broadly ovoid-subglobose nut **1**. **V**. **bella**
  2. Fruiting calyx developed into a woody cup with 5 short, very thick woody lobes, enclosing more than half the length of woody nut
    3. Leaf lateral veins 11–14 per side; venation scalariform; apex obtuse, or broadly and bluntly acute; base obtuse; petioles 1.5–2 cm long. Woody nuts 3–4 cm long, almost entirely (except the apical part) surrounded by adnate woody fruiting calyx cup **7**. **V**. **stapfiana**
    3. Leaf lateral veins 7–9(–11) per side; venation reticulate or scalariform-reticulate; apex acute to acuminate; base acute; petiole 0.8–1.5 cm long. Woody nut not exceeding 3 cm in length, 1/3–2/3 of nut body enclosed by adnate woody fruiting calyx cup with 5 short, broadly obtuse lobes **8**. **V**. **umbonata**
1. Fruiting calyx developed into 2 long and 3 short wings, all exceeding nut body
  4. Fruiting calyx wings forming a short basal tube tightly enclosing 1/2–3/4 of nut body. Corolla white **6**. **V**. **odorata**
  4. Fruiting calyx wings free down to a broad base subtending nut body. Corolla white, or pinkish-red
    5. Leaves oblong or oblanceolate-oblong, 15–26 cm long, rusty pubescent beneath; lateral veins 19–25 pairs; venation obviously scalariform. Corolla white **5**. **V**. **nitens**
    5. Leaves oblong, 4–14 cm long, puberulous or glabrous beneath; lateral veins 9–14 pairs; venation reticulate or scalariform-reticulate. Corolla white, or pinkish-red

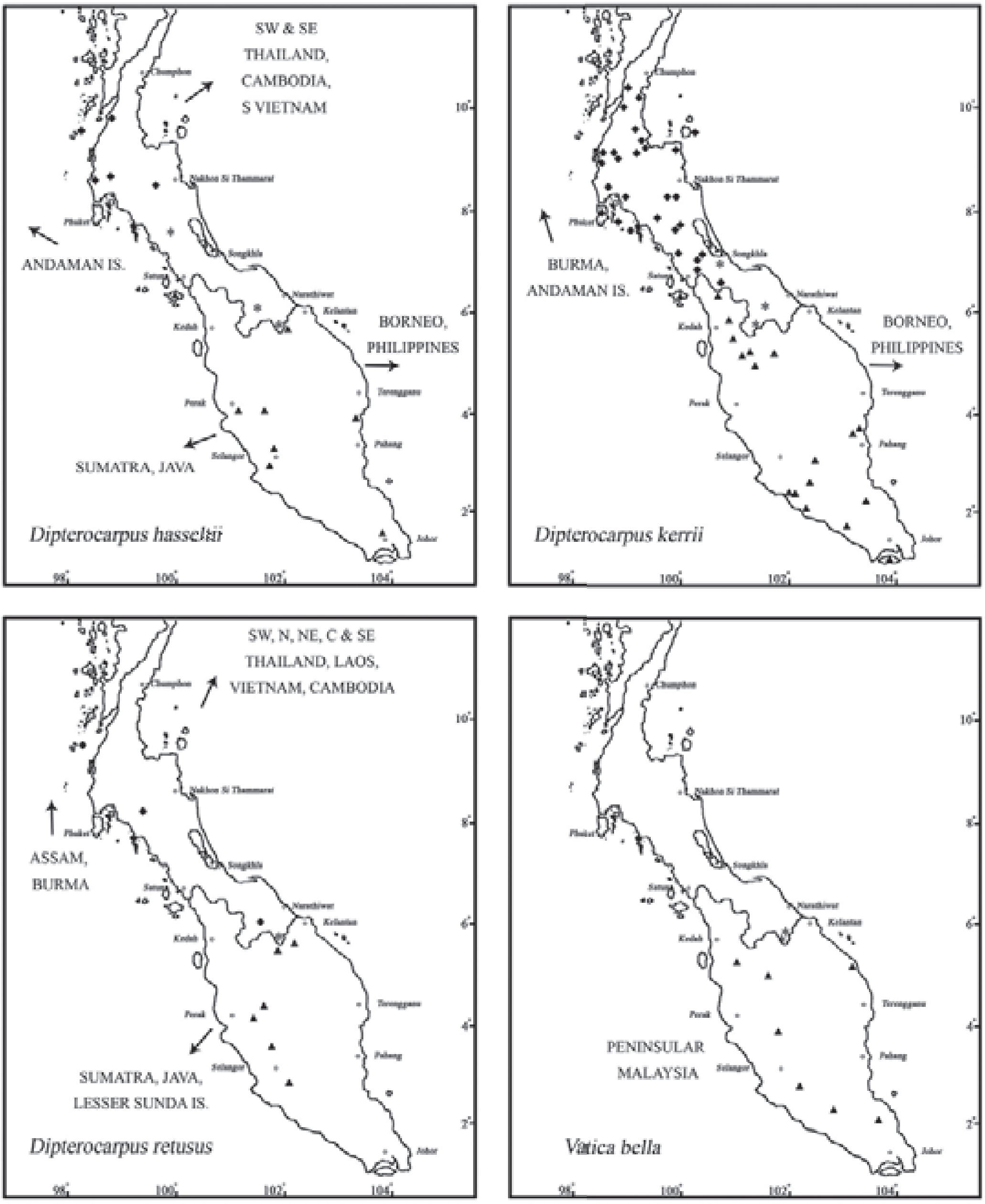

Figure 6. Distribution maps of *Dipterocarpus hasseltii*, *D.kerrii*, *D. retusus* and *Vatica bella* in Peninsular Thailand-Malaysia (♦ Pooma (2003), ▲ Symington (1943) and * Authors)

6. Fruiting calyx wings 3.3–4.6 cm long. Corolla white **3. V. lowii**
6. Fruiting calyx wings exceeding 5 cm in length. Corolla white or pinkish red
   7. Corolla white. Fruiting calyx wings 7–9 cm long; nut broadly ovoid, 1–1.5 cm long. Young leaves yellowish green. Leaves 9–14 cm long, glabrous above, puberulous to glabrescent beneath **2. V. cuspidata**
   7. Corolla pinkish red. Fruiting calyx wings 5–7.5 cm long; nut subglobose, 0.8–1 cm long. Young leaves reddish pink. Leaves 6–12 cm long, glabrous on both surfaces **4. V. maingayi**

1. Vatica bella Slooten, Bull. Jard. Bot. Buitenzorg, III, 9: 102, f. 6. 1927; Symington, Malayan Forest Rec. 16: 218, t. 104. F. 2. 1943; Ashton, Fl. Mal. Ser. I, Spermatophyta 9: 352. 1982; Pooma, Thai For. Bull. (Bot.) 30: 13. 2002. Figs. 17, 22A.

Thailand.— PENINSULAR: Narathiwat (Sukhirin & Waeng districts).

Distribution.— Peninsular Malaysia. (Fig. 6).

Ecology.— Rare, sporadically found on undulating areas in lowland evergreen dipterocarp forest; altitude up to ca. 300 m. Flowering: March–April. Fruiting: Janualy–Febuary.

Additional specimens.— *Poopath-B82*, 16 Oct. 2004, Sukhirin, Narathiwat (**BKF**); *Poopath-B133*, 1 April 2006, Waeng, Narathiwat (**BKF**).

2. Vatica cuspidata (Ridl.) Symington, Malayan Forester. 3: 200. 1934; Malayan Forest Rec.16: 219, t. 106, f. 1. 1943; Ashton, Fl. Mal. Ser. I, Spermatophyta 9: 546. 1982.— *Synaptea cuspidata* Ridl., J. Straits Branch Roy. Asiat. Soc. 82: 172. 1920; Fl. Mal. Pen. 1: 242. 1922.— *S. maingayi* Ridl., Fl. Mal. Pen. 1: 240. 1922.— *Vatica maingayi* auct. non Dyer: Slooten, Bull. Jard. Bot. Buitenzorg III, 9: 85, 1927. Figs. 17, 23D.

Thailand.— PENINSULAR: Yala (Betong), Narathiwat (Sukhirin).

Distribution.— Peninsular Malaysia. (Fig. 7).

Ecology.— Rare, frequently gregarious on high ridges or hilltops in hill evergreen dipterocarp forest; alt. 800–900 m. Flowering: April–July. Fruiting: September–October.

Additional specimens.— *Poopath-A107*, 7 Sept. 2005, Betong, Yala (**BKF**); *Poopath-B86*, 22 May 2005, Betong, Yala (**BKF**); *Poopath-B108*, 24 Oct. 2003, Sukhirin, Narathiwat (**BKF**); *Poopath-B132*, 31 March 2006, Sukhirin, Narathiwat (**BKF**).

Note.— A newly recorded species for Thailand. *V. cuspidata* is one of the group of species with 2 long wings. It is very similar to *V. lowii* and *V. maingayi*. *V. cuspidata* has brown dry leaves, a 1.5–2.5 cm long petiole, a white flower, and 6.5–9 cm long fruit wings with a sightly dilated base. *V. lowii* has brown dry leaves, a 0.6–1.4 cm long petiole, the flower colour is unknown, and 3.3–4.6 cm long fruit wing with a slightly dilated base. *V. maingayi* has reddish-brown dry leaves, a 1.5–2 cm long petiole, a red flower, and 5–7.5 cm long winged fruit with a valvate non-dilated base.

3. Vatica lowii King, J. Asiat. Soc. Bengal, Pt. 2, Nat. Hist. 62(2): 103, p.p. 1893; *emend*. Symington, Malayan Forest Rec. 16: 222, t. 108, f. 2. 1943; Ashton, Fl. Mal. Ser. I, Spermatophyta 9: 369. 1982.— *V. perakensis* King, J. Asiat. Soc. Bengal, Pt. 2, Nat. Hist. 62(2): 103. 1893; Symington, Malayan Forest Rec. 16: 226, t.111, f.1. 1943.— *Synaptea lowii* (King) Ridl., Fl. Mal. Pen.1: 241. 1922. Figs. 17, 23C.

Thailand.— PENINSULAR: Narathiwat (Sukhirin).

Distribution.— Peninsular Malaysia. (Fig. 7).

Ecology.— Rare, scattered on hill slopes or ridges in lowland evergreen dipterocarp forest; alt. 300–400 m. Flowering: April. Fruiting: April –September.

Additional specimen.— *Poopath-B136*, 25 Aug. 2006, Sukhirin, Narathiwat (**BKF**).

Note.— The distinguishing characteristics of *Vatica lowii* are described under *V. cuspidata*. *V. lowii* was reported from Ranong province by Smitinand et al. (1980). However no specimens from Ranong have been found (Pooma & Newman 2001). Symington (1943) and Ashton (1982) reported that *V. lowii* was distributed in Malaysia in a small area of Perak, along the border with Kelantan. That locality is close to Narathiwat Province, Thailand. It is unlikely that *V. lowii* is also to be found in Ranong in the upper part of Peninsular Thailand, where it would be disjunct from the main population by approximately 500 km. This study is, therefore, the first confirmed record of *V. lowii* in Thailand where it is known only from Hala-Bala forest.

4. **Vatica maingayi** Dyer, Fl. Brit. India. 1: 302. 1874; Symimgton, J. Malayan Branch Roy. Asiat. Soc. 19(2): 151. 1943; Malayan Forest Records 16: 223, t. 109, f. 1. 1943; Ashton, Fl. Mal. Ser. I, Spermatophyta 9: 369, f. 47. 1982.— *Synaptea maingayi* Ridl., Fl. Mal. Pen. 1: 240. 1922.— *S. lowii* Ridl., Fl. Mal. Pen.1: 241. 1922.— *Vatica macroptera* Slooten ex Thorenaar, Meded. Proefstat. Boschw. 16: 120, t. 21. 1926.— *V. aperta* Slooten, Bull. Jard. Bot. Buitenzorg III(17): 250. 1942. Figs. 17, 23A–B.

Thailand.— PENINSULAR: Songkhla (Boripat waterfall), Narathiwat (Sukhirin & Waeng districts).

Distribution.— Peninsular Malaysia, Singapore, Sumatra, Borneo (Sarawak, Sabah). (Fig. 7).

Ecology.— Very rare, sporadic on undulating areas to hillsides or along stream in lowland and hill evergreen dipterocarp forests; alt. 100–500 m. Flowering: April. Fruiting: June–July.

Additional specimens.— *Poopath-B56*, 8 Oct. 2004, Sukhirin, Narathiwat (**BKF**); *Poopath-B95*, 5 April 2005, Sukhirin, Narathiwat (**BKF**); *Poopath-B106*, 15 May 2005, Sukhirin, Narathiwat (**BKF**); *Poopath-B120*, 12 July 2005, Sukhirin, Narathiwat (**BKF**).

Note.— A newly recorded species for Thailand. The distinguishing characteristics of *Vatica maingayi* are given under *V. cuspidata*.

5. **Vatica nitens** King, J. Asiat. Soc. Bengal, Pt.2, Nat. Hist. 62(2): 104. 1893; Symington, Malayan Forest Rec. 16: 223, t. 109, f. 2. 1943; Ashton, Man. Dipterocarp. Brunei: 78, f. 10. 1964; Fl. Mal. Ser. I, Spermatophyta 9: 367. 1982.— *Synaptea nitens* (King) Ridl., Fl. Mal. Pen. 1: 241. 1922.— *Vatica cuspidata* auct. non (Ridl.) Symington: Browne, Forest Trees Sarawak & Brunei: 100. 1955. Figs. 17, 22B.

Thailand.— PENINSULAR: Narathiwat (Sukhirin & Waeng districts).

Distribution.— Peninsular Malaysia, Borneo (Sarawak, Sabah). (Fig. 7).

Ecology.— Rare, sporadic on undulating terrains or hill slopes in lowland evergreen dipterocap forest; altitude up to ca. 300 m. Flowering: April. Fruiting: July.

Additional specimens.— *Poopath-B89*, 4 April 2005, Waeng, Narathiwat (**BKF**); *Poopath-B101*, 14 May 2005, Waeng, Narathiwat (**BKF**); *Poopath-B109*, 9 July 2005, Waeng, Narathiwat (**BKF**).

Note.— A newly recorded species for Thailand. The distibguishing characteristics for Vatica nitens are in the large oblong leaves (14–25 x 4–7.5 cm) and the numerous pairs of secondary veins (19–25 pairs) in a genus where other species generally do not have more than 15 pairs. In addition, it has scalariform venation rather than the reticulate venation or scalariform-reticulate venation in other speces. It has the largest fruit wings (7.5–10.5 x 2–3.3 cm) of the genus in Thailand. These wings have a distinctly dilated and recurved base.

6. **Vatica odorata** (Griff.) Symington, J. Malay. Br. Roy. Asiat. Soc. 19: 156. 1941; Malayan Forest Rec. 16: 224, t. 105, f. 2. 1943; Smitinand, Thai For. Bull. (Bot.) 12: 84. 1980; Ashton, Fl. Mal. Ser. I, Spermatophyta 9: 360. 1982; Pooma & Newman, Thai For. Bull. (Bot.) 29: 181. 2001; Pooma, Thai For. Bull. (Bot.) 30: 14. 2002.— *Synaptea odorata* Griff., Not. Pl. Asiat. 4: 516. 1854.— *Vatica faginea* Dyer in Hook.f., Fl. Brit. Ind. 1(2): 301. 1874; Craib, Fl. Siam. 1: 141. 1925.— *V. grandiflora* Dyer in Hook.f., Fl. Brit. Ind. 1(2): 301. 1874.— *V. astrotricha* Hance, J. Bot. 14: 241. 1876.— *Synaptea faginea* (Dyer) Pierre, Fl. Forest. Cochinch. 3(15): t. 243. 1891.— *S. dyeri* Pierre, Fl. Forest. Cochinch. 3(15): t. 241. 1891.— *Vatica curtisii* King, J. Asiat. Soc. Bengal, Pt. 2, Nat. Hist. 62(2): 106. 1893.— *Perissandra laotica* Gagnep., Bull. Soc. Bot. France 95: 27. 1948. Fig. 17.

Thailand.— NORTHERN: Lamphun, Phrae, Lampang, Phitsanulok; EASTERN: Nakhon Ratchasima; SOUTH-EASTERN: Chanthaburi, Prachinburi; SOUTH-WESTERN: Uthai Thani, Prachuap Khiri Khan; PENINSULAR: Chumphon, Ranong, Surat Thani, Krabi, Satun, Songkhla, Yala (Betong).

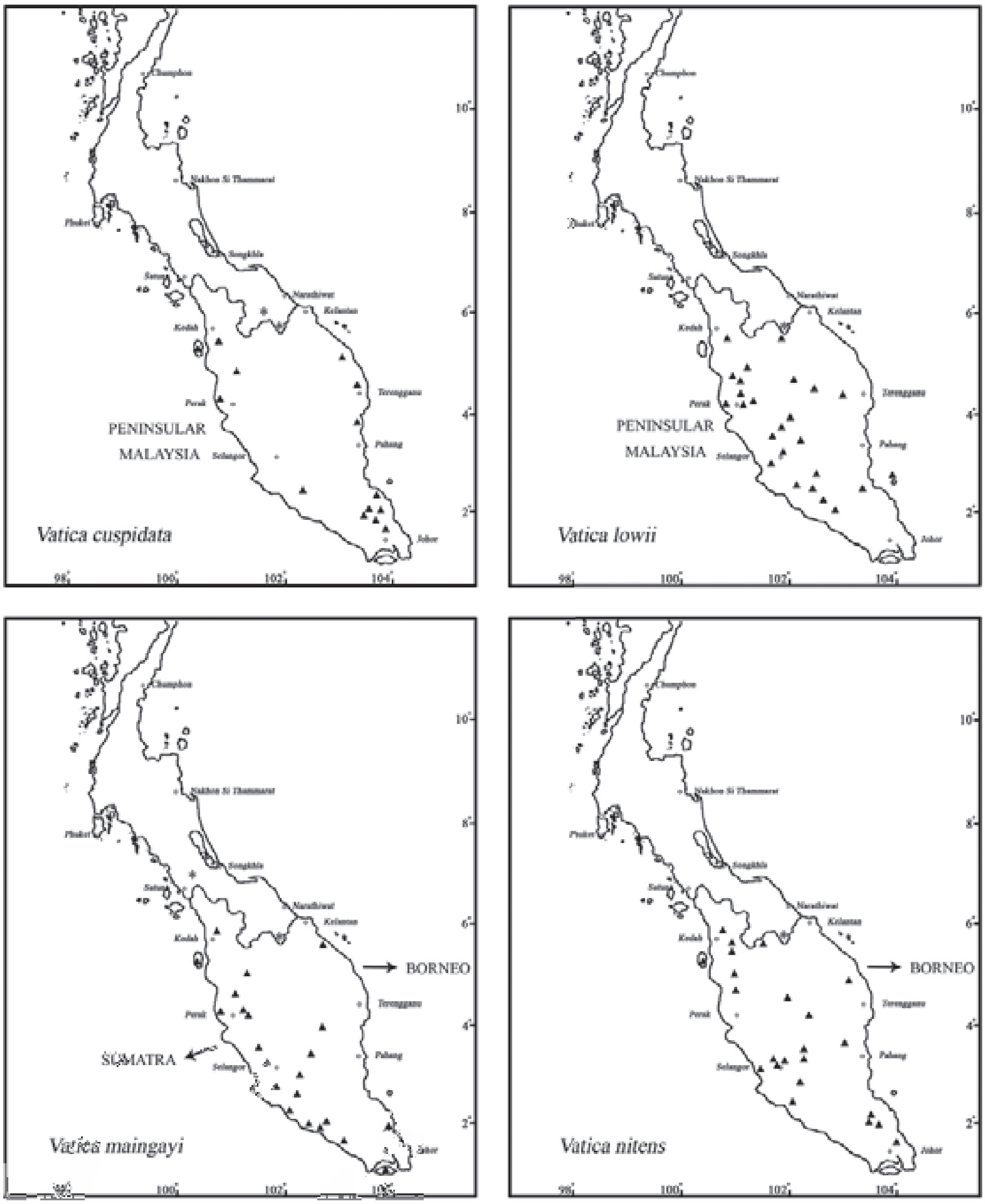

Figure 7. Distribution maps of *Vatica cuspidata*, *V. lowii*, *V. maingayi*, and *V. nitens* in Peninsular Thailand-Malaysia (♦ Pooma (2003), ▲ Symington (1943) and * Authors)

Distribution.— Burma (Tenasserim), Laos, Cambodia, Vietnam, S. China, Peninsular Malaysia, Singapore, Borneo (Brunei, Kalimantan, Sabah), Philippines. (Fig. 8).

Ecology.— Common, gregarious on dry ridges in lowland and hill evergreen dipterocarp forests; alt. 450–700 m. Fruiting: September.

Additional specimens.— *Poopath-A105-a*, 2 Sept. 2005, Betong, Yala (**BKF**); *Poopath-A105-b*, 2 Sept. 2005, Betong, Yala (**BKF**).

7. **Vatica stapfiana** (King) Slooten, J. Asiat. Soc. Bengal, Pt. 2, Nat. Hist. 62(2): 136. 1893; Symington, Malayan Forest Rec. 16: 228, t. 112, f. 2. 1943; Smitinand, Thai For. Bull. (Bot.) 12: 86. 1980; Ashton, Fl. Mal. Ser. I, Spermatophyta 9: 349. 1982; Pooma & Newman, Thai For. Bull. (Bot.) 29: 184. 2001.— *Pachynocarpus stapfianus* King, J. Asiat. Soc. Bengal, Pt. 2, Nat. Hist. 62(2): 135. 1893; Craib, Fl. Siam. 1: 140. 1925.— *P. wallichii* (Dyer) King, J. Asiat. Soc. Bengal, Pt. 2, Nat Hist. 62(2): 135. 1893.— *P. grandiflorus* Ridl., J. Fed. Malay States Mus. 10: 127. 1920; Craib, Fl. Siam. 1:140. 1925. Figs. 17, 22C.

Thailand.— PENINSULAR: Surat Thani, Satun, Yala (Betong & Than To districts), Narathiwat (Waeng).

Distribution.— Cambodia, Peninsular Malaysia, Sumatra. (Fig. 8).

Ecology.— Common, scattered on undulating to ridged terrains in lowland evergreen dipterocarp forest; alt. to ca. 300 m. Flowering: March. Fruiting: March–October.

Additional specimens.— *Poopath-B69*, 11 Sept. 2004, Waeng, Narathiwat (**BKF**); *Poopath-B87*, 8 March 2005, Waeng, Narathiwat (**BKF**).

8. **Vatica umbonata** (Hook. f.) Burck, Ann. Jard. Bot. Buitenzorg 6: 232. 1887; Ashton, Fl. Mal. Ser. I, Spermatophyta 9: 349. 1982; Pooma, Thai For. Bull. (Bot.) 30: 15. 2002.— *Pachynocarpus umbonatus* Hook.f., Trans. Linn. Soc. London, Bot. 23: 159, t. 22. 1860; Ridl., Fl. Mal. Pen. 1: 249,.1922, p.p..— *Vatica verrucosa* Burck, Ann. Jard. Bot. Buitenzorg 6: 232, t. 29, f. 5. 1887.— *Pachynocarpus verrucosus* (Burck) F.Heim, Rech. Dipt.: 107. 1892; Ridl., Fl. Mal. Pen.1: 249. 1922, p.p.. — *Vatica cupularis* Slooten, Bull. Jard. Bot. Buitenzorg III(9): 132, t. 13. 1927.— *V. stapfiana* Browne, Forest Trees Sarawak & Brunei: 102. 1955. Figs. 17, 22D.

Thailand.— PENINSULAR: Yala (Bannang Sata, Betong, Than To districts).

Distribution.— Peninsular Malaysia, Borneo, Philippines. (Fig. 8).

Ecology.— Rare, scattered on ridges or hilltops in hill evergreen dipterocarp forest; alt. 300–800 m. Flowering: April. Fruiting: December –January.

Additional specimens.— (typical *V. umbonata*): *Poopath-A19*, 19 Oct. 2004, Than To, Yala (**BKF**); *Poopath-A31*, 19 Oct. 2004, Bannang Sata, Yala (**BKF**); *Poopath-A38*, 19 Oct. 2004, Than To, Yala (**BKF**). (variant, *V. umbonata*) *Poopath-B28*, 22 June 2004, Waeng, Narathiwat (**BKF**); *Poopath-B72*, 14 Oct. 2004, Waeng, Narathiwat (**BKF**); Poopath-B135, 24 Aug. 2006, Waeng, Narathiwat (**BKF**); *Poopath-B65*, 10 Sept. 2006, Waeng, Narathiwat (**BKF**).

Note.— Some specimens from one tree exhibit woody fruiting calyx cup with more or less truncate lobes, thus a normal local variant.

4. PARASHOREA

Kurz., J. Asiat. Soc. Bengal, Pt. 2, Nat. Hist. 39(2): 65. 1870; Symington, Malayan Forest Rec. 16: 97. 1943; Smitinand, Thai For. Bull. (Bot.) 12: 57. 1980; Ashton, Fl. Mal. Ser. I, Spermatophyta 9(2): 379. 1982.

The genus *Parashorea* consists of 14 species, distributed from Burma, S. China, Indochina, and Malesia. Two species are recorded for Thailand of which one species is in the Hala-Bala forest complex.

Parashorea stellata Kurz, J. Asiat. Soc. Bengal, Pt. 2, Nat. Hist. 39: 66. 1870; Craib, Fl. Siam. 1: 144. 1925; Ridl., Fl. Mal. Pen. 1: 234. 1922; Smitinand, Thai For. Bull. (Bot.) 12: 57. 1980; Ashton, Fl. Mal. Ser. I, Spermatophyta 9: 383. 1982; Pooma & Newman, Thai For. Bull. (Bot.) 29: 154, f. 6. 2001.— *Shorea stellata* (Kurz) Dyer in Hook.f., Fl. Brit. Ind. 1: 304. 1874.— *S. cinerea*

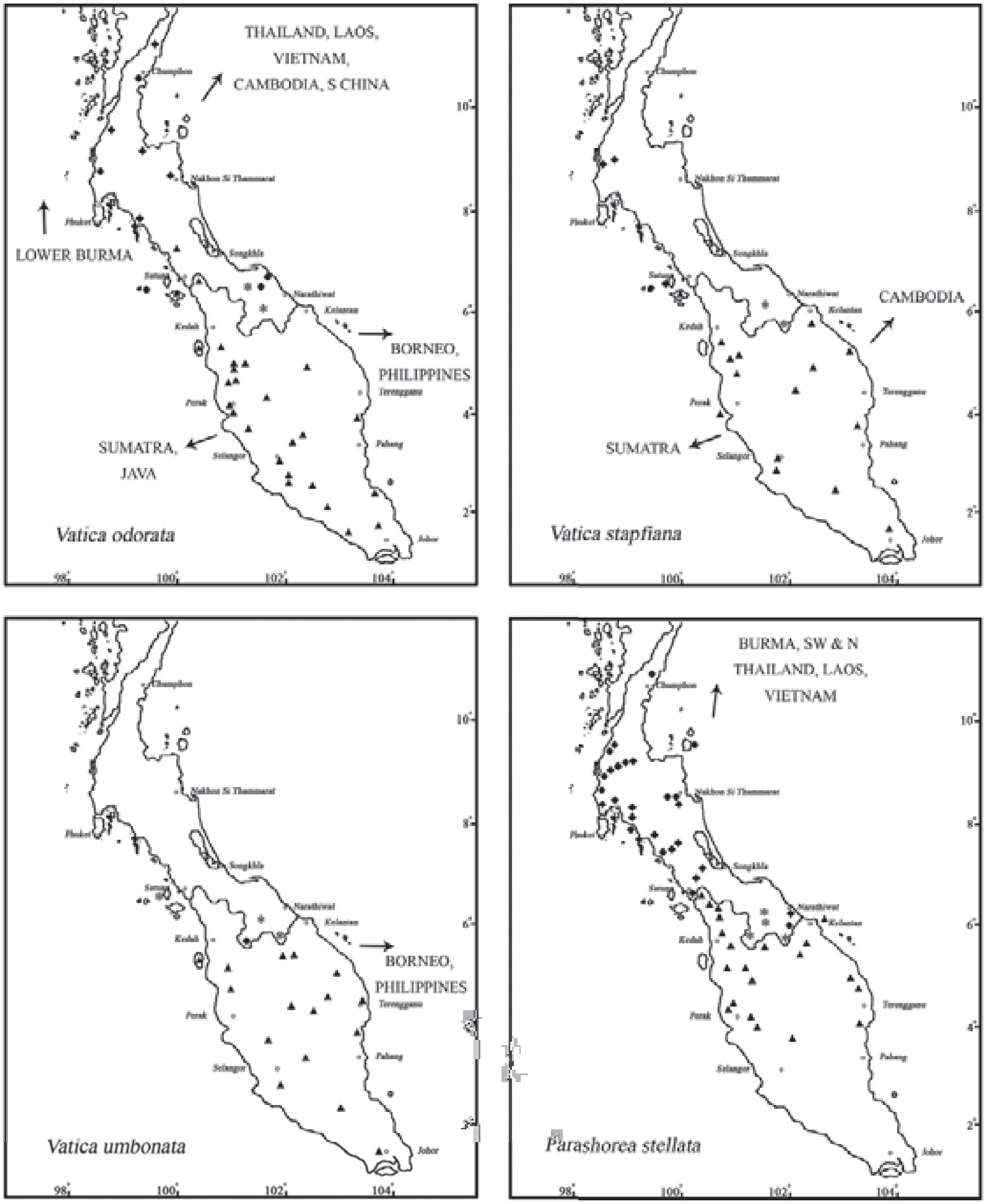

Figure 8. Distribution maps of *Vatica odorata*, *V. stapfiana*, *V. umbonata* and *Parashorea stellata* in Peninsular Thailand-Malaysia (♦ Pooma (2003), ▲ Symington (1943) and * Authors).

C.E.C. Fisch., Bull. Misc. Inform. Kew 1926: 460. 1926.— *Parashorea lucida* (Miq.) Kurz, Symington, Malayan Forest Rec. 16: 102, t. 48, f. 1. 1943.— *P. poilanei* Tardieu-Blot, Not. Syst. (Paris) 10(3): 136. 1942. Fig. 18.

Thailand.— NORTHERN: Lamphun; SOUTH-WESTERN: Kanchanaburi, Ratchaburi, Prachuap Khiri Khan; PENINSULAR: Surat Thani, Phangnga, Phuket, Nakhon Si Thammarat, Trang, Satun, Songkhla, Yala (Bannang Sata, Than To, Betong districts), Narathiwat (Ban Bukit, Muang, Ba Cho, Waeng, Sukhirin districts).

Distribution.— Burma, Laos, Vietnam, Peninsular Malaysia. (Fig. 8).

Ecology.— Very common, scattered or gregarious on ridges or hill slopes in lowland to upper evergreen dipterocarp forests; alt. 100–1,000 m. Flowering: May. Fruiting: July–October.

Additional specimens.— *Poopath-A4*, 6 May 2004, Than To, Yala (**BKF**); *Poopath-A35*, 18 July 2004, Than To, Yala. (**BKF**); *Poopath-B98*, 13 May. 2005, Sukhirin, Narathiwat (**BKF**); *Poopath-B122*, 11 July 2005, Sukhirin, Narathiwat (**BKF**); *Poopath-B130*, 24 Oct. 2003, Sukhirin, Narathiwat (**BKF**).

5. NEOBALANOCARPUS

P.S.Ashton, Gard. Bull. Singapore 31(1): 27. 1978.— *Balanocarpus* King, J. Asiat. Soc. Bengal, Pt. 2, Nat. Hist. 62(2): 133. 1893; Ridl., Fl. Mal. Pen. 1: 247, 1922; Symington, Malayan Forest Rec. 16: 147, t. 70,71. 1943; Smitinand, Thai For. Bull. (Bot.) 12: 23. 1980.

Monotypic genus found only in Peninsular Thailand and Malaysia.

Neobalanocarpus heimii (King) P.S.Ashton, Gard. Bull. Singapore 31(1): 27. 1978; Fl.Mal. I, 9: 388. 1982; Pooma & Newman, Thai For. Bull. (Bot.): 29, f. 5. 2001.— *Balanocarpus heimii* King, J. Asiat. Soc. Bengal, Pt. 2, Nat. Hist. 62(2): 134. 1893; Ridl., Fl. Mal. Pen. 1: 247. 1922; Symington, Malayan Forest Rec. 16: 147, t. 70,71. 1943; Smitinand, Thai For. Bull. (Bot.) 12: 23. 1980.— *Balanocarpus wrayi* King, J. Asiat. Soc. Bengal, Pt. 2, Nat. Hist. 62(2): 134. 1893.— *Pierrea penangiana* F.Heim ex Brandis, J. Linn. Soc., Bot. 31: 110. 1895. Fig. 18.

Thailand.— PENINSULAR: Narathiwat (Ba Cho, Rueso, Ban Tanyong Mas, Ban Bukit, Tanyong Mat, Sungai Padi, Waeng, Sukhirin districts).

Distribution.— Peninsular Malaysia. (Fig. 9).

Ecology.— Rare, sporadic on ridges or hill slopes in lowland and hill evergreen dipterocarp forests; alt. 300–600 m. Flowering: July. Fruiting: Janualy–April.

Additional specimens.— *Poopath-B81*, 15 Oct. 2004, Waeng, Narathiwat (**BKF**); *Poopath-B86*, 12 March 2005, Waeng, Narathiwat (**BKF**); *Poopath- B25*, 10 July 2005, Waeng, Narathiwat (**BKF**).

6. HOPEA

Roxb., Pl. Coromandel 3(1): 7. 1811.— *Neisandra* Rafin., Sylva tellur.: 163. 1838.— *Hoppea* Endl., Gen.: pl. 1014. 1840.— *Hancea* Pierre, For. Fl. Cochin. 4: sub t. 244. 1891.— *Pierrea* F.Heim, Bull. Mens. Soc. Linn. Paris 2: 958. 1891.— *Dioticarpus* Dunn, Bull. Misc. Inform. Kew 1920: 337. 1920.— *Pierreocarpus* Ridl. ex Symington, Gard. Bull. Straits Settlem. 8(1): 30. 1934.

The genus *Hopea* consists of 112 species, distributed from Sri Lanka, India, Bangladesh, Burma, S. China, Hainan, Indochina and Malesia. Nineteen species are recorded for Thailand of which nine species are in the Hala-Bala forest complex.

KEY TO THE SPECIES

1. Leaf lateral veins uniformly pinnate; venation obviously scalariform; leaf base symmetrical or asymmetrical. Nut pubescent or glabrous. Stilt roots present or lacking
  2. Leaf base symmetrically acute; domatia lacking. Corolla deep red. Fruiting calyx wings 8–10 cm long. Stilt roots present **8**. **H**. **sublanceolata**
  2. Leaf base more or less asymmetrical; domatia obvious. Corolla white, yellowish-white. Fruiting calyx wings 3–6 cm long. Stilt roots lacking

3. Young twigs glabrous. Leaves glabrous on both surfaces; domatia pocket-like, glabrous. Stamens 15. Nut ovoid, pubescent; fruiting calyx wings with 10–11 longitudinal veins **5. H. odorata**

3. Young twigs pubescent to puberulous. Leaves glabrous above, pubescent beneath; domatia with short tufted hairs. Stamens 10. Nut subglobose, glabrous; fruiting calyx wings with 7–9 longitudinal veins **7. H. sangal**

1. Leaf lateral veins dryobalanoid or subdryobalanoid-pinnate (Fig. 3), with long or short intermediate veins in between; venation obscurely scalariform or invisible; leaf base symmetrical. Nut glabrous. Stilt roots present (except in *H. montana*)

4. Leaf lateral veins dryobalanoid-pinnate, with long intermediate veins in between; domatia present or lacking. Inflorescence bracts caducous

5. Domatia densely white hairy. Ovary with prominent short-cylindric stylopodium **6. H. pedicellata**

5. Domatia glabrous. Ovary with slender stylopodium

6. Three inner fruiting calyx developed into long lobes to c. 2 cm long, entirely enclosing nut body; base of nut prominent, c. 4 mm long.Young leaves pinkish red or reddish mauve **9. Hopea sp.**

6. Three inner fruiting calyx developed into broad, coriaceous, shorter lobes, almost enclosing nut body; base of nut not prominent, less than 2 mm long. Young leaves pale green

7. Leaves and fruiting calyx wings turning black to brownish black when dry, usually domatia. Fruiting calyx wings 5–7 cm long **2. H. dryobalanoides**

7. Leaves and fruiting calyx wings turning brown when dry, domatia absent. Fruiting calyx wings 3–4.5 cm long **3. H. latifolia**

4. Leaf lateral veins subdryobalanoid-pinnate, with shorter intermediate veins in between; domatia present. Inflorescence bracts persistent

8. Two outer calyx lobes developed into 2 large wings, 4.5–6 cm long. Young twigs peltate scaly. Leaves glabrous, shiny above, glaucous and usually with pale brown peltate scales beneath **4. H. montana**

8. All calyx lobes developed into 5 coriaceous, suborbicular lobes, entirely enclosing nut body. Young twigs puberulous. Leaves glabrous on both surfaces **1. H. bracteata**

1. Hopea bracteata Burck, Ann. Jard. Bot. Buitenzorg 6: 239. 1887; J. Linn. Soc., Bot. 31: 111. 1895; Ashton, Fl. Mal. Ser. I, Spermatophyta 9: 414. f. 70A–A4. 1982.— *H. bracteata* var. *penangiana* Symington, Malayan Forest Rec.16: 133, t. 62, f. 1. 1943.— *H. bracteata* var. *perakensis*, Symington; Malayan Forest Rec.16: 133, t. 62, f. 1. 1943.— *Balanocarpus curtisii* King, J. Asiats. Soc. Bengal, Pt. 2, Nat. Hist. 62(2): 131. 1893; Ridl., Fl. Mal. Pen. 1: 246. 1922.— *B. bracteatus* Merr., Bibl. Enum. Born. Pl. 407. 1921.— *Hopea minima* Symington, Gard. Bull. Straits. Stettlem. 10: 337, pl. 11. 1939. Fig. 18, 25A.

Thailand.— PENINSULAR: Narathiwat (Sukhirin).

Distribution.— Peninsular Malaysia, Borneo, Sumatra. (Fig. 9).

Ecology.— Very rare, gregarious on ridges or hill slopes in lowland evergreen dipterocarp forest; alt. 200–300 m. Flowering: April–May. Fruiting: June–July.

Additional specimens.— *Poopath-S2*, 5 April 2005, Sukhirin, Narathiwat (**BKF**); *Poopath-B103*, 15 May 2005, Sukhirin, Narathiwat (**BKF**).

Note.— A newly recorded species for Thailand. *Hopea bracteata* has many distinctive characteristics such as its small size as a small-medium tree 6–26 m high, flowers which are 25 mm diameter, sharp buttresses with stilt roots, and smooth bark. The leaves are ovate or oblong-ovate, thin and with a smooth surface. The leaf venation is ambigiously subdryobalanoid. The petals are dark red.The fruits are wingless and ovoid and the pink/red small protuberances distinguish this species from other *Hopea* spp. in Hala-Bala forest.

2. Hopea dryobalanoides Miq., Fl. Ned. Ind. Eerste bijv.: 492. 1861; Symington, Malayan Forest Rec. 16: 123, t. 57, f. 1. 1943; Ashton, Fl. Mal. Ser. I, Spermatophyta 9: 402, f. 12, 13, 62 b-d. 1982.— *Hancea dryobalanoidea* Pierre, Fl. Forest. Coch. 4, t. 244. 1891.— *Hopea sarawakensis* F.Heim, Bull. Mens. Soc. Linn. Paris 2: 971. 1891.— *H. borneensis* F.Heim, Bull. Mens. Soc. Linn. Paris 2: 972. 1891.— *H. micrantha* auct. non Hook.f.: King, J. Asiat. Soc. Bengal, Pt. 2, Nat. Hist. 62 (2): 126. 1893. Fig. 18, 24C.

Thailand.— PENINSULAR: Yala (Bannang Sata & Than To districts).

Distribution.— Peninsular Malaysia, Sumatra, Borneo. (Fig. 9).

Ecology.— Very rare, infrequently found on undulating areas, along stream courses, on ridges or hill slopes in lowland and hill evergreen dipterocarp forests; alt. 150–600 m. Flowering: April. Fruiting: July–October.

Additional specimens.— *Poopath-A73*, 15 July 2004, Than To, Yala (**BKF**); *Poopath-A97*, 14 July 2005, Bannang Sata, Yala (**BKF**); *Poopath-A104*, 15 July 2005, Than To, Yala (**BKF**); *Poopath-A131*, 2 Oct. 2005, Bannang Sata, Yala (**BKF**).

Note.— A newly recorded species for Thailand. Generally, *Hopea dryobalanoides* is similar to other species in the genus in the dryobalanoid venation, the yellow colour of the leaves before falling, leaves which become brown to black when dried, and axillary domatia on the lower leaf surface. The stamen appendages are 2 times longer than the anthers. The fruits have wings (3.5–)5–6 x 0.5–1.5 cm and the upper parts are black-brown when dried. *H*. *latifolia* and *H*. *pedicellata* of *Hopea* sect. *Dryobalanoides* are the most similar species. *H*. *latifolia* has brown dried leaves with no domatia. The appendages are as long as the anthers. The ovary has no stylopodium. Its fruit has wings which are shorter and smaller (3–4.5 x 0.6–0.8 cm). *H*. *pedicellata* has brown dried leaves with domatia. The appendages are 2–2.5 times as long as the anthers. The ovary has a distinct stylopodium. The fruit wing is a similar size to *H*. *latifolia*.

3. **Hopea latifolia** Symington, Gard. Bull. Straits Settlem. 10(2): 360. 1939; Malayan Forest Rec. 16: 131, t. 61, f. 1. 1943; Smitinand, Thai For. Bull. (Bot.) 12: 49. 1980; Ashton, Fl. Mal. Ser. I, Spermatophyta 9: 404. 1982; Pooma & Newman, Thai For. Bull. (Bot.) 29: 146. 2001.— *H. intermedia* auct. non King: Foxw., Malayan Forest Rec. 10: 134. 1932.— *H. beccarina* auct. non Burck: Symington, Gard. Bull. Straits Settlem. 9: 325. 1938. Fig. 18.

Thailand.— PENINSULAR: Songkhla, Yala (Than To), Narathiwat (Waeng).

Distribution.— Peninsular Malaysia, Borneo (Brunei, Sarawak, Kalimantan). (Fig. 9).

Ecology.— Very rare, infrequently found on ridges or hill slopes in lowland evergreen dipterocarp forest; alt. 100–300 m. Flowering: May–July. Fruiting: July–August.

Additional specimens.— *Poopath-A71*, 21 June 2005, Than To, Yala (**BKF**); *Poopath-A102*, 15 July 2005, Than To, Yala (BKF); *Poopath-B71*, 14 Oct. 2004, Waeng Narathiwat (**BKF**); *Poopath-B111*, 10 July 2005, Waeng, Narathiwat (**BKF**); *Poopath-B116*, 10 June 2005, Waeng, Narathiwat (**BKF**).

4. **Hopea montana** Symington, J. Malayan Branch Roy. Asiat. Soc. 19(2): 141, pl. 1A. 1941; Malayan Forest Rec.16: 133, t. 62, f. 2. 1943; Ashton, Fl. Mal. Ser. I, Spermatophyta 9: 413. 1982. Figs. 18, 24D.

Thailand.— PENINSULAR: Yala (Bannang Sata & Betong districts).

Distribution.— Peninsular Malaysia, Borneo (Sabah), Sumatra. (Fig. 10).

Ecology.— Very rare, gregarious on ridges in hill and upper evergreen dipterocarp forests; alt. 750–1,000 m. Fruiting: August.

Additional specimens.— *Poopath-A61*, 20 Oct. 2004, Bannang Sata, Yala (**BKF**); *Poopath-A95*, 14 July 2005, Bannang Sata, Yala (**BKF**).

Note.— A newly recorded species for Thailand. The distinguishing characteristics of *Hopea montana* are the longitudinally cracked bark, the dark yellow-pink inner bark, and the lanceolate-ovate or lanceolate leaves. The leaves are 5.5–8 cm long with scales on the midrib. The leaves are also carinate and have subdryobalanoid venation, the immature fruit has red-pink wings, and the tip of stylopodium is truncate. This species is found only in high montainous areas. Neither Symington (1943), Ashton (1982) nor in this study were flowers collected so information on flowers is lacking. However, it could be assumed that the flowers are dark red like other species in *Hopea* subsect. *Sphaerocarpae*.

5. **Hopea odorata** Roxb., Pl. Coromandel 3: 7, t. 210. 1819; Craib, Fl. Siam. 1: 147. 1925; Symington, Malayan Forest Rec. 16: 137, t. 64, f. 2. 1943; Smitinand, Thai For. Bull. (Bot.) 12: 50. 1980; Ashton, Fl. Mal. Ser. I, Spermatophyta 9: 422, f. 73. 1982; Pooma & Newman, Thai For. Bull. (Bot.) 29:146. 2001.— *H. faginea* Hort. Calcuttenses ex A.DC., Prodr. 16 (2): 632. 1868. Fig. 18.

Thailand.— NORTHERN: Chiang Mai, Lamphun,

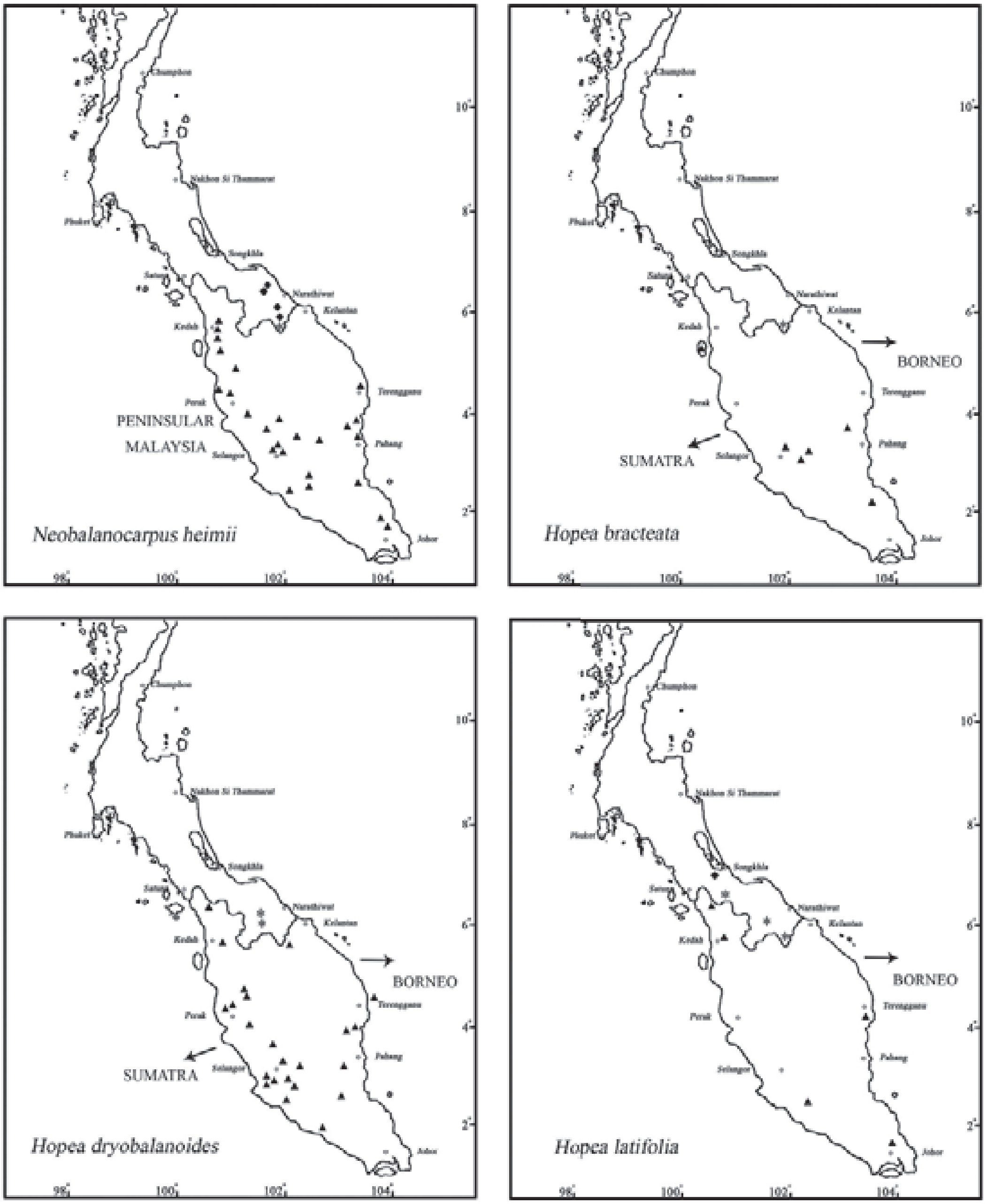

Figure 9. Distribution maps of *Neobalanocarpus heimii*, *Hopea bracteata*, *H. dryobalanoides* and *H. latifolia* in Peninsular Thailand-Malaysia (♦ Pooma (2003), ▲ Symington (1943) and * Authors).

Lampang, Phayao, Tak, Sukhothai, Phichit, Nakhon Sawan; NORTH-EASTERN: Phetchabun, Loei; EASTERN: Chaiyaphum, Nakhon Ratchasima, Buri Ram, Surin; SOUTH-WESTERN: Uthai Thani, Kanchanaburi, Ratchaburi, Prachuap Khiri Khan; CENTRAL: Ang Thong, Bangkok; SOUTH-EASTERN: Prachin Buri, Chon Buri, Rayong, Trat; PENINSULAR: Chumphon, Surat Thani, Phangnga, Nakhon Si Thammarat, Trang, Satun, Songkhla, Pattani, Yala (Than To), Narathiwat (Ba Cho, Tak Bai, Sungai Padi districts).

Distribution.— Bangladesh, Burma, Andaman & Nicobar Islands, Laos, Cambodia, Vietnam, Peninsular Malaysia. (Fig. 10).

Ecology.— Widespread throughout the country, but very rare and infrequently found in the Hala-Bala forest complex, in lowland evergreen dipterocarp forest, along stream courses; alt. 100–150 m. Flowering: April–May. Fruiting: June.

Additional specimen.— *Poopath-A13*, 17 May 2005, Than To, Yala (**BKF**).

6. **Hopea pedicellata** (Brandis) Symington, Gard. Bull. Straits Settlem. 9(4): 327, pl. 19. 1938; Smitinand, Thai For. Bull. (Bot.) 12: 51. 1980; Ashton, Fl. Mal. Ser. I, Spermatophyta 9: 408. 1982, *excl. syn. Hopea siamensis* F.Heim; Pooma & Newman, Thai For. Bull. (Bot.) 29: 149. 2001.— *H. micrantha* King, J. Asiat. Soc. Bengal, Pt. 2, Nat. Hist. 62(2): 124. 1893; Ridl., Fl. Mal. Pen. 1: 237. 1922, non Hook. f. 1860.— *H. griffithii* var. *pedicellata* Brandis, J. Linn. Soc., Bot. 31: 69. 1895; Ridl., Fl. Mal. Pen. 1: 238. 1922.— *H. intermedia* Brandis, J. Linn. Soc., Bot. 31: 67. 1895, non Miq. 1860.— *H. mengerawan* Brandis, J. Linn. Soc. Bot. 31: 70. 1895, non Miq. 1860.— *H. pierrei* Ridl., Fl. Mal. Pen. 1: 238. 1922. Fig. 18.

Thailand.— PENINSULAR: Trang, Satun, Yala (Bannang Sata, Betong, Than To districts), Narathiwat (Sukhirin & Waeng districts).

Distribution.— Cambodia, Peninsular Malaysia, Singapore, Borneo (Kalimantan, Sabah, Sarawak). (Fig. 10).

Ecology.— Common, gregarious on ridges or hilltops in lowland and hill evergreen dipterocarp forests; alt. 150–600 m. Flowering: April–May. Fruiting: July.

Additional specimens.— *Poopath-A15*, 11 April 2005, Than to, Yala (**BKF**); *Poopath-A96*, 14 July 2005, Bannang sata, Yala (**BKF**); *Poopath-A100*, 15 July 2005, Bannang sata, Yala (**BKF**); *Poopath-A106*, 3 Sept. 2005, Betong, Yala (**BKF**); *Poopath-B117*, 11 July 2005, Sukhirin, Narathiwat (**BKF**); *Poopath-B102*, 15 May 2005, Sukhirin, Narathiwat (**BKF**); *Poopath-B104*, 15 May 2005, Sukhirin, Narathiwat (BKF); *Poopath-B119*, 11 July 2005, Sukhirin, Narathiwat (**BKF**).

7. **Hopea sangal** Korth., Verh. Nat. Gesch. Ned. Bezitt., Bot. 75. 1841; Symington, Malayan Forest Rec. 16: 141, t. 67, f. 2. 1943; Smitinand, Thai For. Bull. (Bot.) 12: 53. 1980; Ashton, Fl. Mal. Ser. I, Spermatophyta 9: 420; Pooma & Newman, Thai For. Bull. (Bot.) 29: 2001.— *H. curtisii* King, J. Asiat. Soc. Bengal, Pt. 2, Nat. Hist. 62(2): 126. 1893.— *H. globosa* Brandis, J. Linn. Soc., Bot. 31: 61. 1895.— *H. lowii* Dyer ex Brandis, J. Linn. Soc., Bot. 31: 63. 1895.— *H. minutiflora* C.E.C. Fisch., Bull. Misc. Inform. Kew 1927: 207. 1927. Fig. 18.

Thailand.— PENINSULAR: Surat Thani, Phangnga, Nakhon Si Thammarat, Trang, Yala (Bannang Sata, Betong, Than To districts), Narathiwat (Waeng).

Distribution.— Burma, Peninsular Malaysia, Singapore, Borneo, Sumatra, Java, Lesser Sunda Islands. (Fig. 10).

Ecology.— Rare, scattered along streams, undulating areas to ridged terrains in lowland and hill evergreen dipterocarp forests; alt. 150–550 m. Flowering: May–June. Fruiting: August –September.

Additional specimens.— *Poopath-A9*, 16 July 2004, Than To, Yala (**BKF**); *Poopath-A89*, 25 May 2005, Betong, Yala (**BKF**); *Poopath-B23*, 13 May 2005, Waeng, Narathiwat (**BKF**); *Poopath-B124*, 12 July 2005, Waeng, Narathiwat (**BKF**); *Poopath-B129*, 2 Oct. 2005, Waeng, Narathiwat (**BKF**).

8. **Hopea sublanceolata** Symington, Gard. Bull. Straits Settlem. 10: 341, pl. 13. 1939; Malayan Forest Records 16: 144, t. 69, f. 1. 1943; Ashton, Fl. Mal. Ser. I, Spermatophyta 9: 411. 1982.— *H. nervosa* Foxw., Malayan Forest Rec. 10: 129.

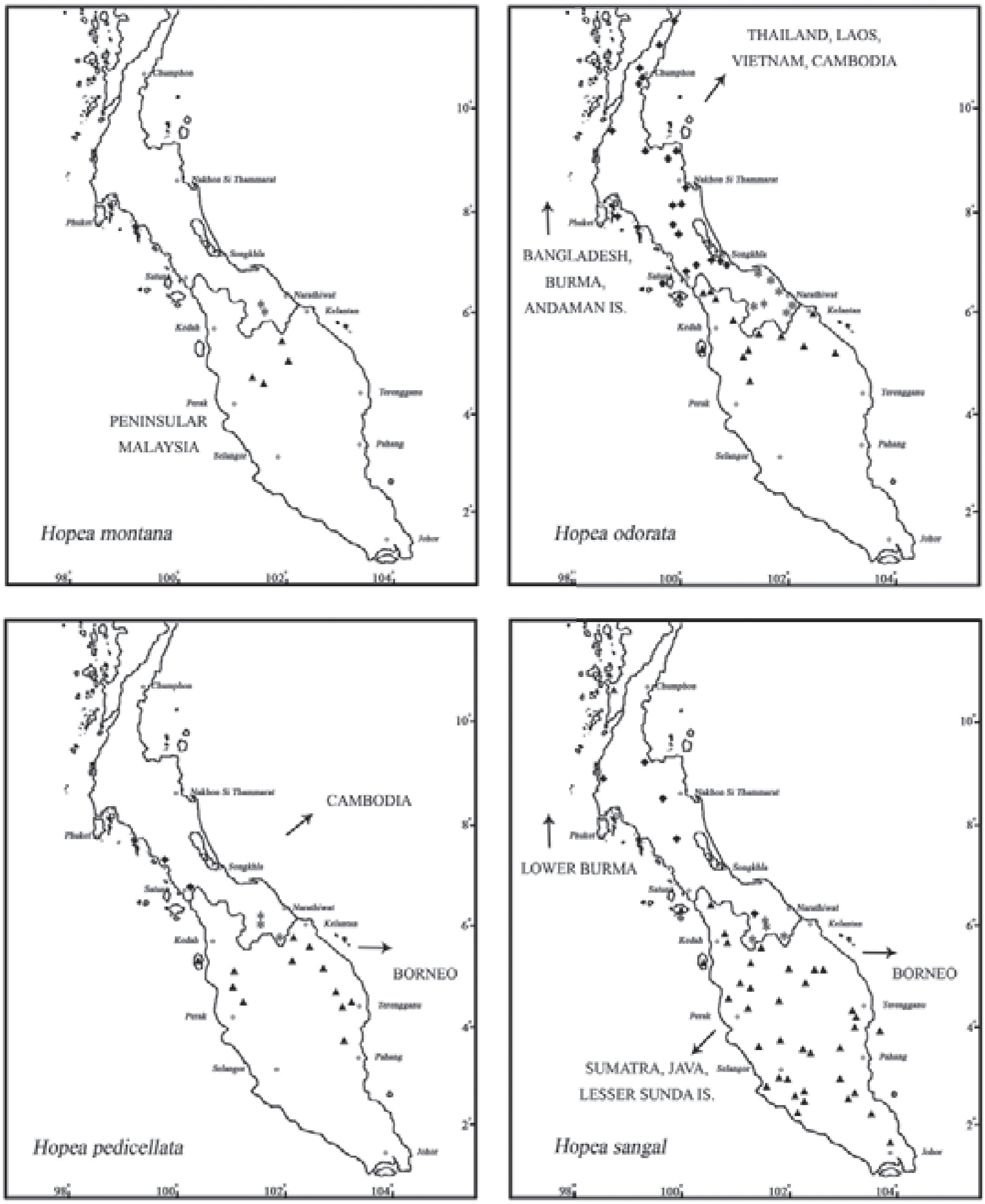

Figure 10. Distribution maps of *Hopea montana*, *H. odorata*, *H. pedicellata* and *H. sangal* in Peninsular Thailand-Malaysia (♦ Pooma (2003), ▲ Symington (1943) and * Authors)

1932, non King 1893. Figs. 18, 24B.

Thailand.— PENINSULAR: Yala (Betong & Than To districts), Narathiwat (Waeng).

Distribution.— Peninsular Malaysia. (Fig. 11).

Ecology.— Rare, scattered or gregarious on undulating areas along stream courses in lowland evergreen dipterocarp forest; altitude up to 150 m. Flowering: May–July. Fruiting: August–September.

Additional specimens.— *Poopath-A21*, 16 July 2004, Than To, Yala (**BKF**); *Poopath-A22*, 14 June 2004, Than To, Yala (**BKF**); *Poopath-A48*, 14 Sept. 2004, Than To, Yala (**BKF**).

9. **Hopea sp.** Fig. 18, 24A.

This likely new *Hopea* sp. belonging to *Hopea* section *Dryobalanoides* subsection *Dryobalanoides* resembles the Malesian *Hopea fluviaris* P.S.Ashton, *H*. *longirostrata* P.S.Ashton and *H*. *sulcata* Symington in general appearance. It differs from them in its smooth bark with deep red inner bark when cut; leaves with more lateral veins (14–18 per side), and base of the nut very thick, supported by remarkably swollen c. 4 mm long receptacle.

Thailand.— PENINSULAR: Narathiwat (Sukhirin & Waeng districts).

Distribution.— Thailand: Narathiwat, Hala-Bala forest. (Fig. 11).

Ecology.— Rare, scattered or gregarious on undulating areas or ridged terrains in lowland evergreen dipterocarp forest; altitude up to ca. 300 m. Flowering: March–May. Fruiting: June–August.

Additional specimens.— *Poopath-B39*, 22 July 2004, Waeng, Narathiwat (**BKF**); *Poopath-B105*, 15 May 2005, Sukhirin, Narathiwat (**BKF**); *Poopath-B110*, 10 July 2005, Waeng, Narathiwat (**BKF**); *Poopath-B113*, 10 June 2005, Waeng, Narathiwat (**BKF**); *Poopath-B118*, 11 July 2005, Sukhirin, Narathiwat (**BKF**); *Poopath-B24*, 22 July 2005, Waeng, Narathiwat (**BKF**).

Note.— *Hopea* sp. is probably a new species endemic to Peninsular Thailand.

7. SHOREA

Roxb. ex C.F.Gaertn., Suppl. Carp. 48. 1805; Smitinand, Thai For. Bull. (Bot.) 12: 57. 1980; Ashton, Fl. Mal. Ser. I, Spermatophyta 9: 436. 1982..— *Doona* Thwaites, Hooker's J. Bot. Kew Gard. Misc. 4: 7. 1852.— *Pentacme* A.DC., Prodr. 16(2): 626. 1886; Symington, Malayan Forest Rec. 16: 104. 1943.— *Isoptera* Scheff. ex Burck, Meded. Lands Plantentuin 3: 27. 1886. — *Ridleyinda* Kunze, Rev. Gen. Pl. 1: 65. 1891.— *Richetia* F.Heim, Bull. Mens. Soc. Linn. Paris 2: 975. 1891.— *Anthoshorea* Pierre ex F.Heim, Rech. Dipterocarp.: 41. 1892.— *Parahopea* F.Heim, Rech. Dipterocarp.: 66. 1892.— *Pachychlamys* Dyer ex Ridl., Fl. Mal. Pen. 1: 233. 1922.

The genus *Shorea* consists of 196 species, widely distributed from Sri Lanka, India, Burma to Indochina and Malesia. Twenty five taxa are recorded for Thailand of which fourteen species and one subspecies are in the Hala-Bala forest complex.

KEY TO THE SPECIES

1. Fruiting calyx wings erect, embracing and slightly exceeding nut body; nut ellipsoid, conical, or short-cylindric, 2.8–4.5 cm long. Corolla red **14**. **S**. **singkawang**
1. Fruiting calyx wings much exceeding nut body; nut ovoid, conical, subglobose to globose, not exceeding 2 cm in length (except in *S. longisperma*). Corolla white, yellowish white, pale yellow, occasionally red at upper part, pink or red at base
 2. Petals falling off separately. Stamens 25–35
  3. Leaves broadly elliptic, scabrid pubescent beneath. Corolla yellowish white in upper part, pinkish red at base. Stamens 24–27 **10**. **S**. **ochrophloia**
  3. Leaves oblong, with sparse short hairs along main veins, or glabrescent beneath. Corolla yellow in upper part, red at base. Stamens 29–35 **6**. **S**. **guiso**
 2. Petals falling off in a rosette. Stamens 14–17(-25)
  4. Leaf venation loosely scalariform. Anthers with 2 pollen sacs
   5. Leaves lanceolate, oblong-lanceolate, glabrous on both surfaces; lateral veins 8–10 pairs; petioles 0.7–1 cm long. Young twig sparsely hairy. Nuts ellipsoid to conical, 1.5–1.8 cm long **4**. **S**. **faguetiana**
   5. Leaves oblong, elliptic-oblong, glabrous above, pubescent to puberulous beneath; lateral veins 11–14 pairs; petioles 1.1–1.5 cm long. Young twig densely hairy. Nuts broadly ovoid-conical-ellipsoid, 2.5–3 cm long **8**. **S**. **longisperma**

4. Leaf venation densely scalariform. Anthers with 4 pollen sacs
6. Leaves without minute red glands beneath. Anther ovoid-cylindric or short-cylindric, apical appendage usually much exceeding anther
7. Leaf lateral veins 8–9 per side. Stamens 15; apical appendage twice to thrice as long as anther **13**. **S**. **pauciflora**
7. Leaf lateral veins 12–20 per side. Stamens 14–25; apical appendage shorter or longer than anther
8. Twig compressed, sparsely scaly or glabrescent. Stamens 25; apical appendage about twice as long as anther **5**. **S**. **gratissima**
8. Twig terete, tomentose or glabrescent. Stamens 14–15
9. Twig tomentose. Leaves broadly elliptic, 4–6.5 cm long, with short tufted hairs beneath; lateral veins 12–14 per side; petioles 4–7 mm long. Corolla white in upper part, pale pink or pinkish white at base. Apical appendage slightly shorter than anther **1. S. assamica**
9. Twig glabrescent. Leaves oblong, elliptic-oblong, 8–16 cm long, pale green, densely white lepidote beneath; lateral veins 16–18 pairs; petioles 12–16 mm long. Corolla white or yellowish white in upper part, red at base. Apical appendage about twice as long as anther **2**. **S**. **bracteolata**
6. Leaves with scattered minute red glands beneath. Anther subglobose-globose; apical appendage equalling to slightly exceeding anther
10. Fruiting calyx wings broadly auriculate at base; both auricles slightly broader than oblong wings, not enclosing ovoid nut. Young leaves orange red. Leaves oblong, 9–15 cm long, glabrous on both surfaces **9**. **S**. **macroptera**
10. Fruiting calyx wings not auriculate at base. Young leaves pale green, yellowish green, or pinkish. Leaf blade variform, usually more or less hairy or scaly beneath
11. Leaves ovate, 3–6(-9) cm long; petioles stout, 0.8–1.3 cm long. Corolla red in upper part, white at base **11**. **S**. **ovata**
11. Leaves oblong, elliptic, or lanceolate in outline, (6–)8–14 cm long; petioles slender, 1–2 cm long. Corolla pale yellow, yellowish white to yellowish green throughout
12. Leaves dark green, glabrous, shiny above, white or brown tomentose to pubescent beneath. Young fruiting calyx wings yellowish green. Mature nut 1.4–1.8 cm long **7**. **S**. **leprosula**
12. Leaves dark green, glabrous, shiny above, pubescent to glabrescent, or lepidote beneath. Young fruiting calyx wings red. Mature nut 0.7–1.3 cm long
13. Leaves lanceolate, lanceolate-elliptic, densely pale lepidote beneath; lateral veins (12–)14–16 per side; domatia lacking. Corolla yellowish white **3**. **S**. **curtisii**
13. Leaves oblong, elliptic, or ovate-elliptic, puberulent or glabrescent beneath; lateral veins 8–11(–12) per side; domatia hairy. Corolla white **12**. **S**. **parvifolia**

1. **Shorea assamica** Dyer subsp. **globifera** (Ridl.) Symington, Gard. Bull. Straits Settlem. 9(4): 331, pl. 20. 1938; Malayan Forest Rec. 16: 31, t. 15, f. 1. 1943; Smitinand, Thai For. Bull. (Bot.) 12: 71. 1980; Ashton, Fl. Mal. Ser. I, Spermatophyta 9: 491, f. 93. 1982; Pooma & Newman, Thai For. Bull. (Bot.) 29: 158. 2001.— *S. globifera* Ridl., Fl. Mal. Pen. 1: 232. 1922.— *S. sororia* Slooten, Bull. Jard. Bot. Buitenzorg 18: 247, f. 9, 10. 1949. Fig. 19.

Thailand.— PENINSULAR: Satun, Songkhla, Yala (Bannang Sata, Betong, Than To districts), Narathiwat (Sukhirin & Waeng districts).

Distribution.— Peninsular Malaysia, Sumatra. (Fig. 11).

Ecology.— Very common, scattered or gregarious by streams, hill slopes or on ridges in lowland and hill evergreen dipterocarp forests; altitude up to ca. 600 m. Flowering: June–July. Fruiting: September–October.

Additional specimens.— *Poopath-A47*, 16 July 2004, Than To, Yala (**BKF**); *Poopath-B16*, 2 May 2004, Sukhirin, Narathiwat (**BKF**); *Poopath- B68*, 10 Sept. 2004, Waeng, Narathiwat (**BKF**); *Poopath-B75*, 15 Oct. 2004, Sukhirin, Narathiwat (**BKF**).

2. **Shorea bracteolata** Dyer, Fl. Brit. Ind. 1(2): 305. 1874; Ridl., Fl. Mal. Pen. 1: 229. 1922; Symington, Malayan Forest Rec. 16: 34, t. 16, f. 1. 1943; Ashton, Man. Dipterocarp. Brunei 163, f. 15. 1964; Fl. Mal. Ser. I, Spermatophyta 9: 496. 1982.— *S. foveolata* Scort. ex Foxw., Malayan Forest Rec. 10: 183. 1932. Fig. 19, 26D.

Thailand.— PENINSULAR: Narathiwat (Waeng).

Distribution.— Peninsular Malaysia, Singapore, Sumatra, Borneo. (Fig. 11).

Ecology.— Very rare, infrequently on undulating areas or ridges in lowland evergreen dipterocarp forest; altitude up to ca. 300 m. Flowering: March–April. Fruiting: May–June.

Additional specimens.— *Poopath-B12*, 3 April 2005, Waeng, Narathiwat (**BKF**); *Poopath-B67*, 10 Sept. 2004, Waeng, Narathiwat (**BKF**); *Poopath-B99*, 14 May 2005, Waeng, Narathiwat (**BKF**).

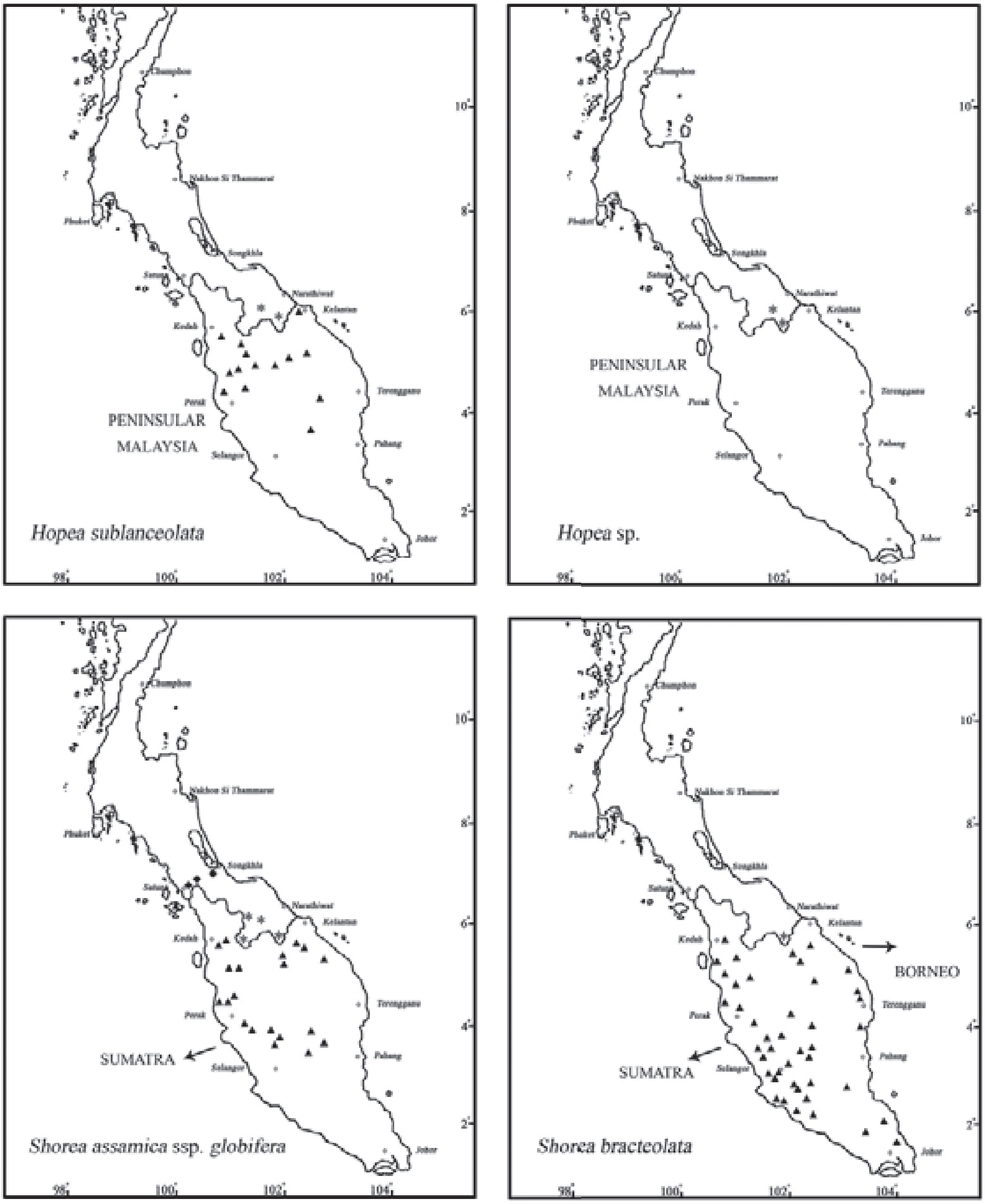

Figure 11. Distribution maps of *Hopea sublanceolata*, *Hopea* sp., *Shorea assamica* and *S. bracteolata* in Peninsular Thailand-Malaysia (♦ Pooma (2003), ▲ Symington (1943) and * Authors).

3. **Shorea curtisii** Dyer ex King, J. Asiat. Soc. Bengal, Pt. 2, Nat. Hist. 62(2): 111. 1893; Ridley, Fl. Mal. Pen. 1: 223. 1922; Craib, Fl. Siam. 1: 142. 1925; Symington, Malayan Forest Rec. 16: 67, t. 33, f. 1. 1943; Ashton, Gard. Bull. Singapore 31(1): 48. 1978; Smitinand, Thai For. Bull. (Bot.) 12: 76. 1980; Ashton, Fl. Mal. Ser. I, Spermatophyta 9: 541. 1982; Pooma & Newman, Thai For. Bull. (Bot.) 29: 158. 2001. Fig. 19.

Thailand.— PENINSULAR: Satun, Yala (Bannang Sata, Than To, Betong districts), Narathiwat (Sukhirin, Sungai Padi, Waeng districts).

Distribution.— Peninsular Malaysia, Singapore, Borneo (Brunei, Sarawak). (Fig. 12).

Ecology.— Very common, locally frequent on ridges or hilltops in stands in lowland and hill evergreen dipterocarp forests; alt. 250–1,000 m. Flowering: May–July. Fruiting: August–September.

Additional specimens.— *Poopath-A17*, 16 July 2004, Than To, Yala (**BKF**); *Poopath-B26*, 13 May 2005, Waeng, Narathiwat (**BKF**); *Poopath-B27*, 8 June 2004, Waeng, Narathiwat (**BKF**); *Poopath-B58*, 8 Sept. 2004, Sukhirin, Narathiwat (**BKF**); *Poopath-B112*, 11 July 2005, Waeng, Narathiwat (**BKF**).

4. **Shorea faguetiana** F.Heim, Bull. Mens. Soc. Linn. Paris 2: 975. 1891; Symington, Malayan Forest Rec. 16: 50, t. 23, f. 1. 1943; Smitinand, Thai For. Bull. (Bot.) 12: 71. 1980; Ashton, Fl. Mal. Ser. I, Spermatophyta 9: 484. 1982; Pooma & Newman, Thai For. Bull. (Bot.) 29: 159. 2001; Pooma, Thai For. Bull. (Bot.) 30: 12. 2002.— *S. ridleyana* King, J. Asiat. Soc. Bengal, Pt. 2, Nat. Hist. 62(2): 115. 1893.— *S. dryobalanoides* Dyer ex Brandis, J. Linn. Soc., Bot. 31: 95. 1895; Ridl., Fl Mal. Pen. 1: 226.1922. Fig. 19.

Thailand.— PENINSULAR: Yala (Bannang Sata, Betong, Than To districts), Narathiwat (Sukhirin & Waeng districts).

Distribution.— Peninsular Malaysia, Borneo (Sabah, Sarawak), Sumatra. (Fig. 12).

Ecology.— Common, scattered on undulating areas or ridges in lowland and hill evergreen dipterocarp forests; altitude up to 600 m. Flowering: April–May. Fruiting: July–August.

Additional specimens.— *Poopath-A103*, 15 July 2005, Than To, Yala (**BKF**); *Poopath-B97*, 13 May 2005, Waeng, Narathiwat (**BKF**); *Poopath-B115*, 10 July 2005, Waeng, Narathiwat (**BKF**).

5. **Shorea gratissima** (Wall. ex Kurz) Dyer in Hook. f., Fl. Brit. Ind. 1(2): 307. 1874; Ridl., Fl. Mal. Pen. 1: 226. 1922; Symington, Malayan Forest Rec.16: 36, t. 17, f. 1. 1943; Smitinand, Thai For. Bull. (Bot.) 12: 72. 1980; Ashton, Fl. Mal. Ser. I, Spermatophyta 9: 487. 1982; Pooma & Newman, Thai For. Bull. (Bot.) 29: 161, f. 7. 2001.— *Hopea gratissima* Wall. ex Kurz, J. Asiat. Soc. Bengal, Pt. 2, Nat. Hist. 42: 61. 1873. Fig. 19.

Thailand.— SOUTH-WESTERN: Prachuap Khiri Khan; PENINSULAR: Chumphon, Surat Thani, Phuket, Nakhon Si Thammarat, Phatthalung, Trang, Songkhla, Yala (Bannang Sata, Betong, Than To districts), Narathiwat (Sukhirin & Waeng districts).

Distribution.— Burma (Tenasserim), Peninsular Malaysia, Singapore, Borneo (Sabah), Sumatra. (Fig. 12).

Ecology.— Very common, scattered or gregarious on ridges or hilltops in lowland to upper evergreen dipterocarp forests; alt. 200–1,200 m. Fruiting: October–November.

Additional specimens.— *Poopath-B15*, 24 Oct. 2003, Sukhirin, Narathiwat (**BKF**); *Poopath-B62*, 9 Sept. 2004, Sukhirin, Narathiwat (**BKF**); *Poopath-B76*, 15 Oct. 2004, Sukhirin, Narathiwat (**BKF**).

Note.— New localities recorded from Narathiwat and Yala provinces.

6. **Shorea guiso** (Blanco) Blume, Mus. Bot. 2: 34. 1852; Symington, Malayan Forest Rec. 16: 16, t. 7, f. 2. 1943; Smitinand, Thai For. Bull. (Bot.) 12: 64. 1980; Ashton, Fl. Mal. Ser. I, Spermatophyta 9: 447.1982; Pooma & Newman, Thai For. Bull. (Bot.) 29: 163. 2001.— *Mocanera guiso* Blanco, Fl. Filip., ed. 1: 449. 1837.— *Dipterocarpus guiso* (Blanco) Blanco, Fl. Filip., ed. 2: 313. 1845.— *Anisoptera guiso* (Blanco) A.DC., Prodr. 16(2): 616. 1868.— *Shorea pierrei* Hance, J. Bot. 16: 302. 1878.— *S. vulgaris* Pierre ex Laness., Pl. Util. Col. Franc.: 301. 1886.— *S. obtusa* var. *kohchangensis*

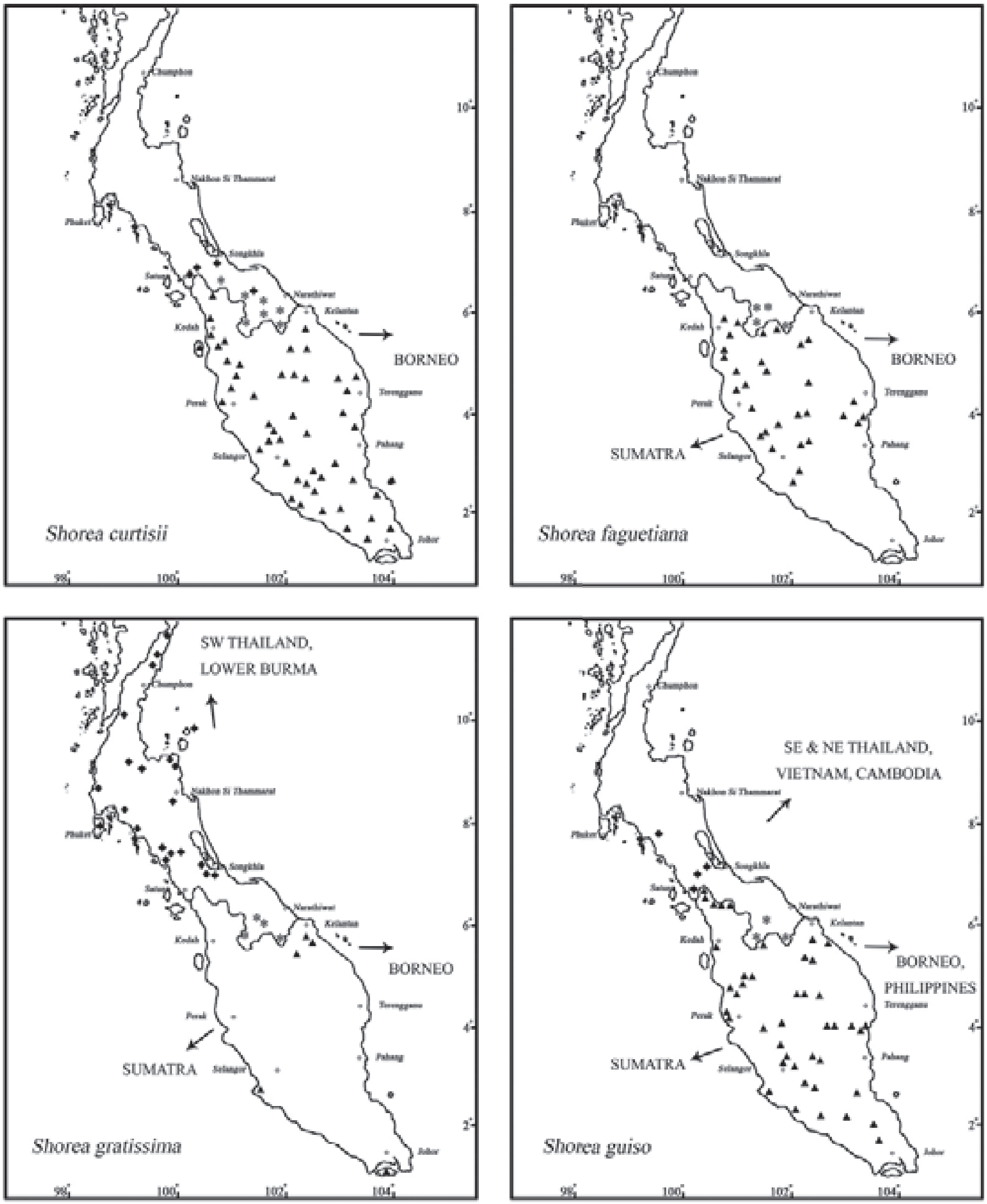

Figure 12. Distribution maps of *Shorea curtisii*, *S. faguetiana*, *S. gratissima* and *S. guiso* in Peninsular Thailand-Malaysia (♦ Pooma (2003), ▲ Symington (1943) and * Authors).

F.Heim, Bot. Tidsskr. 25: 45. 1903.— *S. robusta* var. *schmidtii* F.Heim, Bot. Tidsskr. 25: 45. 1903.— *S. longipetala* Foxw., Malayan Forest Rec. 10: 174. 1932. Fig. 19.

Thailand.— NORTH-EASTERN: Nakhon Phanom; SOUTH-EASTERN: Prachin Buri, Chanthaburi, Trat; PENINSULAR: Trang, Satun, Songkhla, Yala (Bannang Sata, Betong, Than To districts), Narathiwat (Rueso, Sukhirin, Waeng districts).

Distribution.— Vietnam, Cambodia, Peninsular Malaysia, Sumatra, Borneo, Philippines. (Fig. 12).

Ecology.— Common, scattered along streams courses to ridges in lowland and hill evergreen dipterocarp forests; altitude up to 600 m. Flowering: April. Fruiting: June–July.

Additional specimens.— *Poopath-A29*, 14 June 2005, Than To, Yala (**BKF**); *Poopath-B2*, 3 April 2005, Waeng, Narathiwat (**BKF**); *Poopath-B114*, 10 July 2005, Waeng, Narathiwat (**BKF**);.

7. **Shorea leprosula** Miq., Fl. Ned. Ind. Eerst bijv.: 487. 1861; Ridl., Fl. Mal. Pen. 1: 222. 1922; Symington, Malayan Forest Rec. 16: 75, t. 36, f. 2. 1943; Smitinand, Thai For. Bull. (Bot.) 12: 78. 1980; Ashton, Fl. Mal. Ser. I, Spermatophyta 9: 540. 1982; Pooma & Newman, Thai For. Bull. (Bot.) 29: 166. 2001.— *Hopea maranti* Miq., Fl. Ned. Ind., Eerste bijv.: 489. 1860.— *Shorea maranti* (Miq.) Burck, Ann. Jard. Bot. Buitenzorg 6: 217. 1887.— *S. astrosticta* Scort. ex Foxw., Malayan Forest Rec. 10: 220. 1932. Fig. 19.

Thailand.— PENINSULAR: Songkhla, Pattani, Yala (Bannang Sata, Betong, Than To districts), Narathiwat (Sukhirin, Sungai Padi, Waeng districts).

Distribution.— Peninsular Malaysia, Singapore, Borneo, Sumatra, Java. (Fig. 13).

Ecology.— Very common, scattered by streams, undulating to ridged terrains or hilltops in lowland to upper evergreen dipterocarp forests; altitude up to 1,000 m. Flowering: July. Fruiting: October.

Additional specimens.— *Poopath-B37*, 22 July 2004, Waeng, Narathiwat (**BKF**); *Poopath-B63*, 9 Sept. 2004, Sukhirin, Narathiwat (**BKF**); *Poopath-B77*, 15 Oct. 2004, Sukhirin, Narathiwat (**BKF**).

8. **Shorea longisperma** Roxb., Fl. Ind. 2: 618. 1832; Ridl., Fl. Mal. Pen. 1: 143. 1922.— *Parashorea longisperma* Kurz, J. Asiat. Soc. Bengal, Pt. 2, Nat. Hist. 39: 66. 1870.— *Shorea resina-negra* Foxw., Malayan Forest Rec. 10: 205, pl. 16. 1932; Symington, Malayan Forest Rec. 16: 56, t. 26, f. 1. 1943; Ashton, Fl. Mal. Ser. I, Spermatophyta 9: 481. 1982. Figs. 19, 26C.

Thailand.— PENINSULAR: Narathiwat (Sukhirin & Waeng districts).

Distribution.— Peninsular Malaysia, Borneo (Brunei, Sarawak), Sumatra. (Fig. 13).

Ecology.— Very rare, infrequently on hill slopes in lowland evergreen dipterocarp forest; alt. ca. 300 m. Fruiting: July–October.

Additional specimens.— *Poopath-B41*, 22 July 2004, Waeng, Narathiwat (**BKF**); *Poopath-B45*, 23 July 2004, Sukhirin, Narathiwat (**BKF**); *Poopath-B60*, 8 Oct. 2004, Sukhirin, Narathiwat (**BKF**); *Poopath-B127*, 27 Oct. 2005, Sukhirin, Narathiwat (**BKF**).

9. **Shorea macroptera** Dyer in Hook. f., Fl. Brit. Ind. 1(2): 308. 1874; Ridl., Fl. Mal. Pen. 1: 225. 1922; Symington, Malayan Forest Rec. 16: 78, t. 38, f. 1. 1943; Smitinand, Thai For. Bull. (Bot.) 12: 79. 1980; Ashton, Fl. Mal. Ser. I, Spermatophyta 9: 532. 1982; Pooma & Newman, Thai For. Bull. (Bot.) 29: 167. 2001.— *S. auriculata* Scort. ex Foxw., Malayan Forest Rec. 10: 195. 1932. Fig. 19.

Thailand.— PENINSULAR: Yala (Betong).

Distribution.— Peninsular Malaysia, Singapore, Sumatra, Borneo. (Fig. 13).

Ecology.— Very rare, often gregarious on undulating areas or hill slopes in hill evergreen dipterocarp forest; alt. ca. 500 m. Fruiting: June–August.

Additional specimens.— *Poopath-A92*, 11 June 2005, Betong, Yala (**BKF**); *Poopath-A40*, 19 July 2005, Betong, Yala (**BKF**).

10. **Shorea ochrophloia** Strugnell ex Symington, Gard. Bull. Straits Settlem. 8: 268, pl. 17. 1935; Malayan Forest Rec. 16: 112. 1943; Ashton, Fl. Mal. Ser. I, Spermatophyta 9: 447. 1982. Figs. 20, 25C–D.

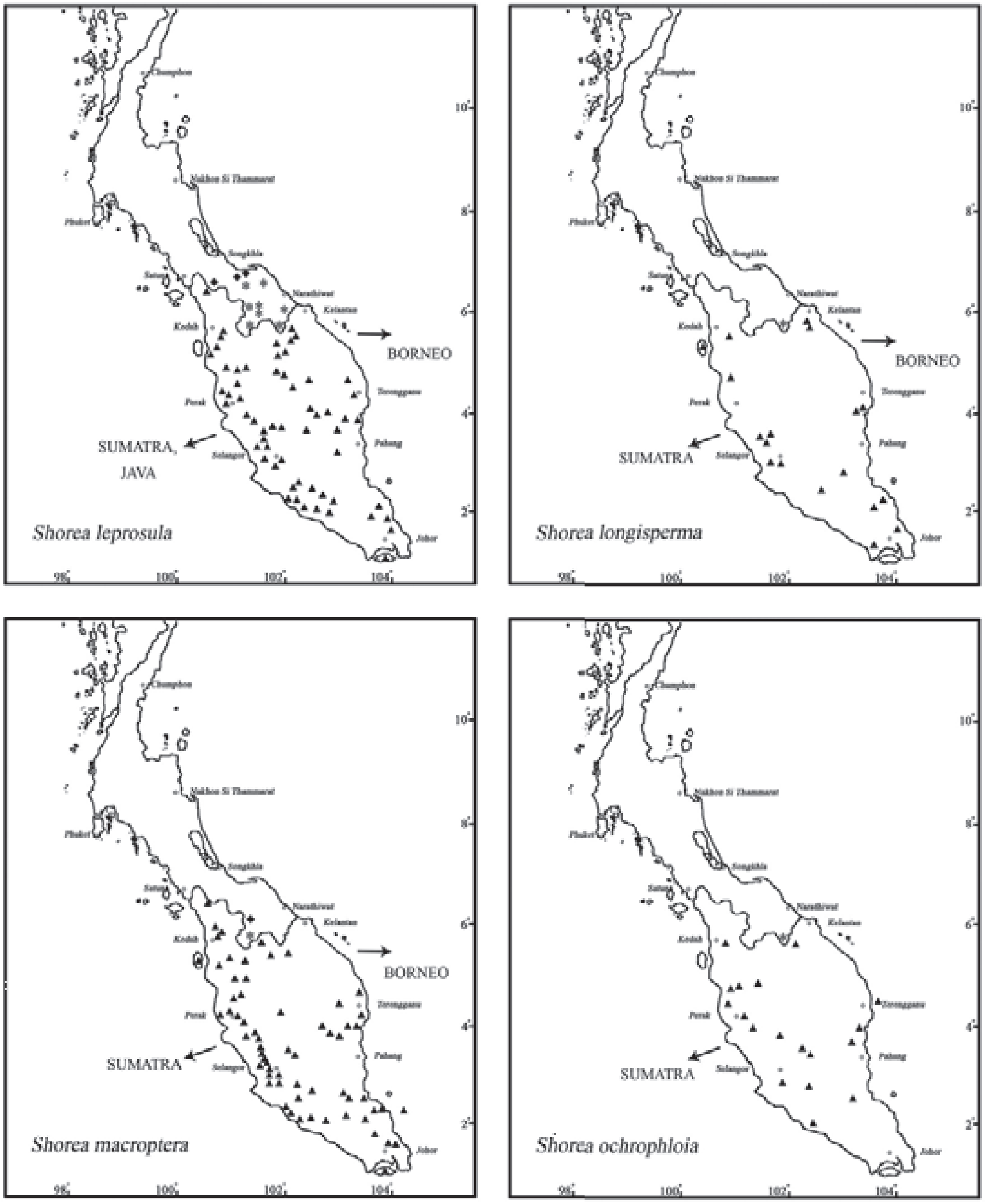

Figure 13. Distribution maps of *Shorea leprosula*, *S. longisperma*, *S. macroptera* and *S. ochrophloia* in Peninsular Thailand-Malaysia (♦ Pooma (2003), ▲ Symington (1943) and * Authors).

Thailand.— PENINSULAR: Narathiwat (Waeng).

Distribution.— Peninsular Malaysia, Sumatra. (Fig. 13).

Ecology.— Very rare, infrequently on undulating terrain in lowland evergreen dipterocarp fores; alt. ca. 150 m. Flowering: April. Fruiting: July.

Additional specimens.— *Poopath-B44*, 22 July 2004, Waeng, Narathiwat (**BKF**); *Poopath-B96*, 5 April 2005, Waeng, Narathiwat (**BKF**).

Note.— A newly recorded species for Thailand. *Shorea ochrophloia* is similar to *S. guiso* in the characetrs that define the section. The differences are that *S. ochrophloia* is tomentose on the lower surface of the leaves and young twigs whereas *S. guiso* is sparsely pubescent. Also *S. ochrophloia* has relatively larger and thicker leaves compared to *S. guiso*. The leaves of *S. ochrophloia* are relatively thick and slightly coriaceous and undulating along the secondary veins but the leaves of *S. guiso* are thinner and smooth. The tips of the petals are light yellow or whitish yellow in *S. ochrophloia* and bright yellow in *S. guiso*.

11. **Shorea ovata** Dyer ex Brandis, J. Linn. Soc. Bot. 31: 91. 1895; Symington, Malayan Forest Rec. 16: 82, t. 39, f.. 2. 1943; Ashton, Man. Dipterocarp. Brunei 230, f. 16. 1964; Fl. Mal. Ser. I, Spermatophyta 9: 545, f. 114. 1982.— *S. parvifolia* King, J. Asiat. Soc. Bengal, Pt. 2, Nat. Hist. 62(2): 112. 1893, non Dyer 1874.— *S. plagata* Foxw., Philipp. J. Sci., C. 13: 192. 1918.— *S. agsaboensis* W.L.Stern, Brittonia 17: 36, f. 1,2. 1965.— *S. parvifolia* subsp. *velutinata* auct. non P.S.Ashton: Pooma & Newman, Thai For. Bull. (Bot.) 29: 169. 2001. Fig. 20, 26B.

Thailand.— PENINSULAR: Yala (Betong & Than To district), Narathiwat (Sukhirin).

Distribution.— Peninsular Malaysia, Sumatra, Borneo, Philippines (Mindanao). (Fig. 14).

Ecology.— Rare, gregarious on dry ridges or hilltops in hill and upper evergreen dipterocarp forests; alt. 500–900 m. Flowering: May–October. Fruiting: September–December.

Additional specimens.— *Poopath-A20*, 15 July 2004, Than To, Yala (**BKF**); *Poopath-A59*, 14 Sept. 2004, Than To, Yala (**BKF**); *Poopath-A66*, 10 April 2005, Than To, Yala (**BKF**); *Poopath-A85*, 22 May. 2005, Betong, Yala (**BKF**, spirit specimen); *Poopath-A94*, 20 June 2005, Than To, Yala; *Poopath-A108*, 10 Sept. 2005, Betong, Yala (**BKF**).

Note.— A newly recorded species for Thailand. *Shorea ovata* is very similar to *S. parvifolia* but *S. ovata* has dark yellow inner bark, the leaves are usually small and 3–6–(9) cm long, and the base of the leaves is cuneate or obtuse. In *S. parvifolia* the inner bark is dark red, the leaves are relatively larger (6–13 cm), and the leaf base is truncate or cordate. Other distinct characteristics of *S. ovata* are the red flowers, petals 5–6 mm long, margin entire, and fruits globose or broadly ovoid. *S. parvifolia* has white floweres, petals 8 mm long, margin dentate and contorted and fruits ovoid.

12. **Shorea parvifolia** Dyer in Hook. f., Fl. Brit. Ind. 1(2): 305. 1874; Ridl., Fl. Mal. Pen. 1: 224. 1922; Foxw., Malayan Forest Rec. 3: 31. 1927; Symington, Malayan Forest Rec. 16: 85, t. 40, f. 2. 1943; Ashton, Gard. Bull. Singapore 20: 278: 1963; Man. Dipt. Brun.: 206, f. 16. 1964; Smitinand, Thai For. Bull. (Bot.) 12: 80. 1980; Ashton, Fl. Mal. Ser. I, Spermatophyta 9: 546. 1982; Pooma & Newman, Thai For. Bull. (Bot.) 29: 169. 2001.

KEY TO THE SUBSPECIES

1. Leaves sparsely pubescent or glabrescent beneath; base obtuse or slightly cordate; margin not revolute; domatia not prominent **S. parvifolia** subsp. **parvifolia**
1. Leaves scabrous hairy beneath; base acute or cuneate; margin often narrowly revolute; domatia prominent **S. parvifolia** subsp. **velutinata**

subsp. **parvifolia**.— *Shorea sutulata* King, J. Asiat. Soc. Bengal, Pt. 2, Nat. Hist. 62(2): 110. 1893; Ridl., Fl. Mal. Pen. 1: 222. 1922. Foxw., Malayan Forest Rec. 10:201. 1932.— *S. gentilis* Parijs, Repert. Spec. Nov. Regni Veg. 33: 224. 1933. Fig. 20.

Thailand.— PENINSULAR: Songkhla, Yala (Bannang Sata, Betong, Than To districts), Narathiwat (Cho Ai Rong, Sungai Padi, Sukhirin, Waeng districts).

Distribution.— Peninsular Malaysia, Singapore, Borneo (Brunei, Kalimantan, Sabah, Sarawak), Sumatra. (Fig. 14).

Ecology.— Very common, scattered on undulating to ridged terrains or by streams in lowland and hill evergreen dipterocarp forests; altitude up to ca. 700 m. Flowering: April–July. Fruiting: September–October.

Additional specimens.— *Poopath-A28*, 13 June 2004, Than To, Yala (**BKF**); *Poopath-B46*, 23 July 2004, Sukhirin, Narathiwat (**BKF**); *Poopath-B64*, 9 Sept. 2004, Sukhirin, Narathiwat (**BKF**); *Poopath-B70*, 14 Oct. 2004, Sukhirin, Narathiwat (**BKF**); *Poopath-B78*, 15 Oct. 2004, Sukhirin, Narathiwat (**BKF**); *Poopath-B88*, 3 April 2005, Waeng, Narathiwat (**BKF**).

subsp. **velutinata** P.S.Ashton, Gard. Bull. Singapore 20: 278. 1963; Fl. Mal. Ser. I, Spermatophyta 9: 547. 1982. Fig. 20, 26A.

Thailand.— PENINSULAR: Yala (Betong).

Distribution.— Peninsular Malaysia, Borneo (Brunei, Kalimantan, Sabah), Sumatra. (Fig. 13).

Ecology.— Very rare, infrequently on un dulating terrain in hill evergreen dipterocarp forests; alt. c. 500 m. Flowering: April. Fruiting: June –July.

Additional specimens.— *Poopath-A41*, 21 April 2005, Betong, Yala (**BKF**); *Poopath-A93*, 11 June 2005, Betong, Yala (**BKF**); *Poopath-A93-1*, 11 June 2005, Betong, Yala (**BKF**).

Note.— A newly recorded subspecies for Thailand. *Shorea parvifolia* subsp. *velutinata* is distinct in the following characters: large leaves with obtuse or acute base, lower leaf surface with tomentose hairs along the midrib, prominent secondary and tertiary veins. *S. parvifolia* subsp. *parvifolia* normally has smaller leaves with obtuse or subcordate base, the lower surface is glabrescent and the secondary veins are rather flat. *S. parvifolia* subsp. *velutinata* was recorded by Pooma & Newman (2001) but their material (*Niyomdhum* 4837, 20 Oct. 1996, Sukhirin, Narathiwat (**BKF**); *Niyomdhum 5541*, 21 Aug. 1998, Sukhirin, Narathiwat (**BKF**) *Niyomdhum 5546*, 21 Aug. 1998, Sukhirin, Narathiwat (**BKF**)) is, in fact, *S. ovata*.

13. **Shorea pauciflora** King, J. Asiat. Soc. Bengal, Pt. 2, Nat. Hist. 62(2): 116. 1893; Ridl., Fl. Mal. Pen. 1: 228. 1922; Symington, Malayan Forest Rec. 16: 87, t. 41, f. 1. 1943; Ashton, Man. Dipterocarp. Brunei 207, f. 17, pl. 46. 1964; Fl. Mal. Ser. I, Spermatophyta 9: 511. 1982. Fig. 20, 25B.

Thailand.— PENINSULAR: Yala (Betong & Than To districts).

Distribution.— Peninsular Malaysia, Singapore, Sumatra, Borneo. (Fig. 14).

Ecology.— Rare, scattered on undulating to ridged terrains in lowland and hill evergreen dipterocarp forests; alt. 200–600 m. Flowering: May. Fruiting: July.

Additional specimens.— *Poopath-A10*, 20 June 2005, Than To, Yala (**BKF**); *Poopath-A70*, 10 April 2005, Than To, Yala (**BKF**); *Poopath-A72*, 17 May 2005, Than To, Yala (**BKF**); *Poopath-A99*, 15 July 2005, Than To, Yala (**BKF**).

Note.— A newly recorded species for Thailand. *Shorea pauciflora* is distinct in its very brown-red dried leaves, tertiary venation densely diagonal, and with tomentose domatia in secondary vein axils. The fruits have very long wings (6–10 cm). The bark is longitudinally scaly and with a reddish pink inner bark.

14. **Shorea singkawang** (Miq.) Miq., Ann. Mus. Bot. Lugd.-Bat. 3: 84. 1867; Symington, Malayan Forest Rec. 16: 92, t. 43, f. 1. 1943; Ashton, Gard. Bull. Singapore 31(1): 47. 1978; Smitinand, Thai For. Bull. (Bot.) 12: 80. 1980; Ashton, Fl. Mal. I. 9: 536. 1982; Pooma & Newman, Thai For. Bull. (Bot.) 29: 176. 2001.— *Hopea singkawang* Miq., Sum. 1: 489. 1860.— *Shorea thiseltonii* King, J. Asiat. Soc. Bengal 62(2): 122. 1893.— *S. forbesii* King ex Brandis, J. Linn. Soc., Bot. 31: 77. 1895.— *Pachychlamys thiseltonii* (King) Ridl., Fl. Mal. Pen. 1: 233. 1922.— *P. beccarianus* auct. non Dyer ex Brandis: Ridl., Fl. Mal. Pen. 1: 233. 1922.— *Shorea hemsleyana* auct. non (King) King ex Foxw.: Smitinand, Thai For. Bull. (Bot.) 12: 78. 1980, p.p. Fig. 20.

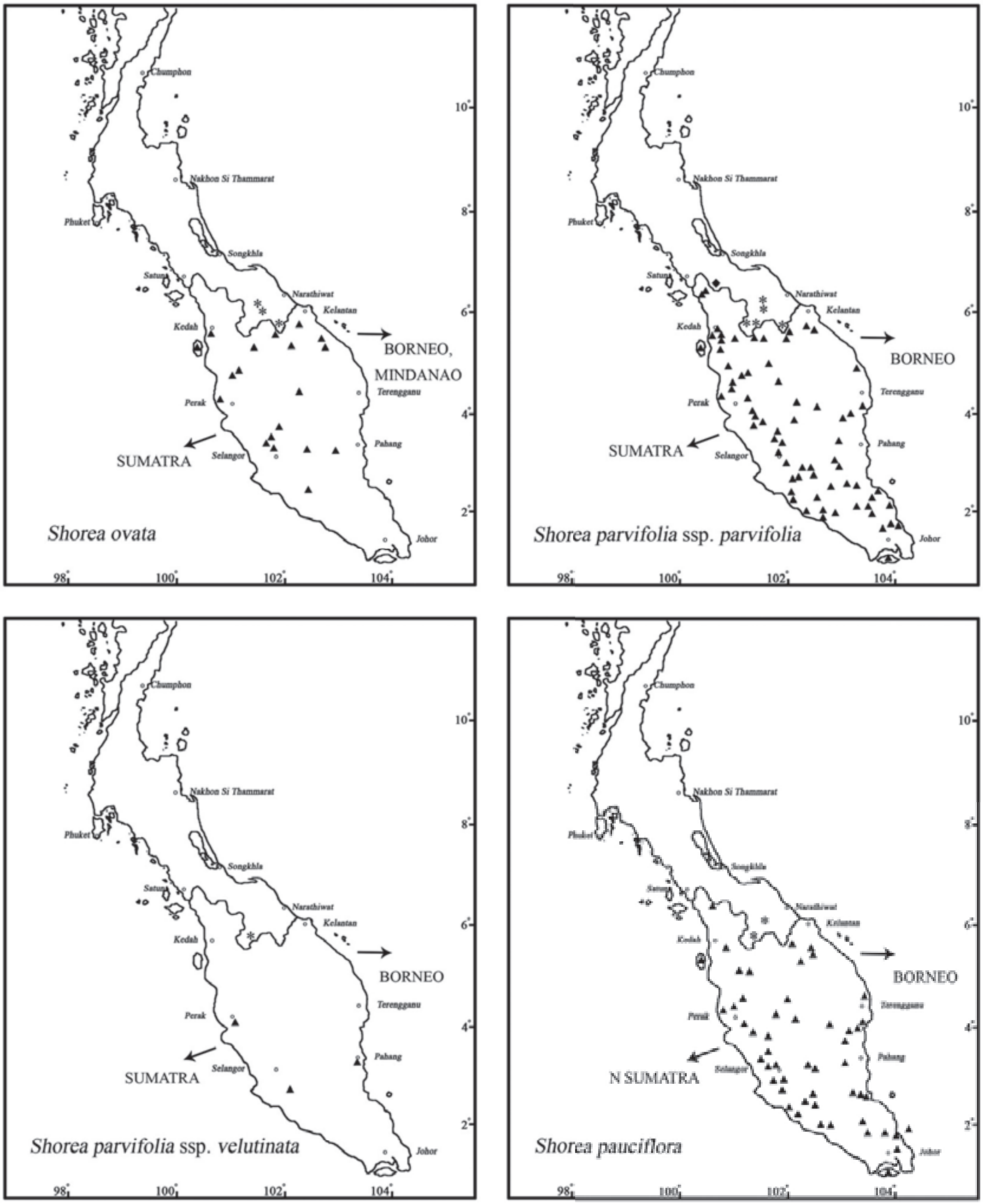

Figure 14. Distribution maps of *Shorea ovata*, *S. parvifolia* ssp. *parvifolia*, *S. parvifolia* ssp. *velutinata* and *S. pauciflora* in Peninsular Thailand-Malaysia (♦ Pooma (2003), ▲ Symington (1943) and * Authors).

Thailand.— PENINSULAR: Narathiwat (Sukhirin & Waeng districts).

Distribution.— Peninsular Malaysia, Sumatra. (Fig. 15).

Ecology.— Rare, infrequently on undulating to ridged terrains in lowland and hill evergreen dipterocarp forests; alt. 200–600 m. Flowering: April–May. Fruiting: July.

Additional specimens.— *Poopath-B21*, 4 April 2005, Sukhirin, Narathiwat (**BKF**); *Poopath-B61*, 3 May 2004, Sukhirin, Narathiwat (**BKF**); *Poopath-B107*, 15 May 2005, Sukhirin, Narathiwat (**BKF**); *Poopath-B121*, 11 July 2005, Sukhirin, Narathiwat (**BKF**).

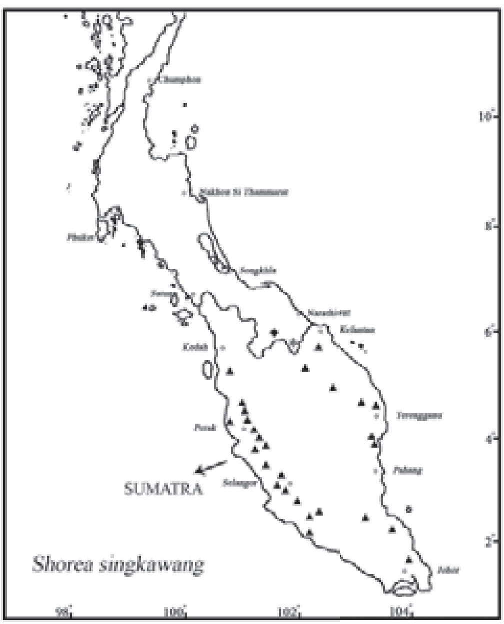

Figure 15. Distribution maps of *Shorea singkawang* in Peninsular Thailand-Malaysia (♦ Pooma (2003), ▲ Symington (1943) and * Authors).

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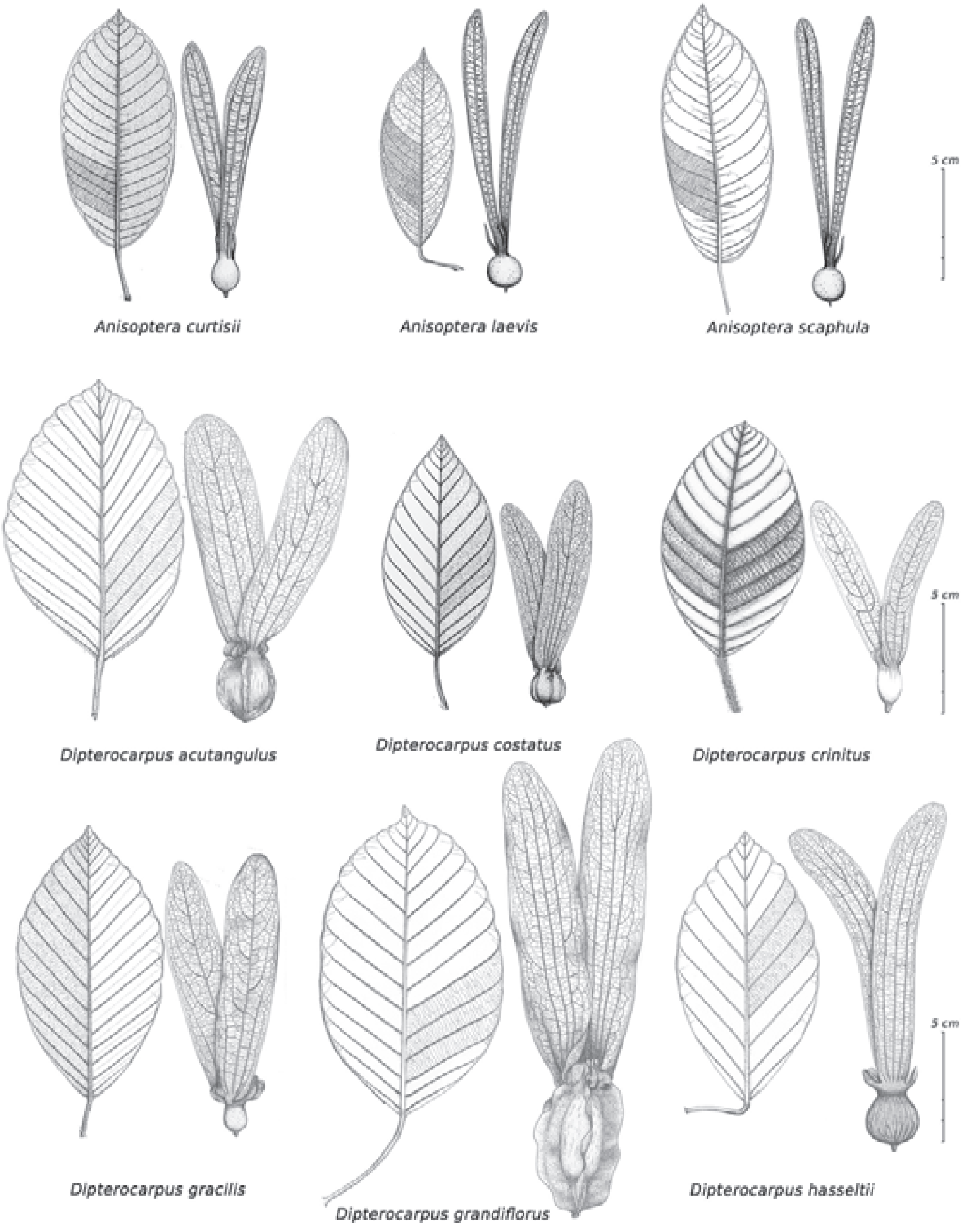

Figure 16. Species of *Anisoptera* and *Dipterocarpus* in the Hala-Bala forest complex: leaves and fruits.

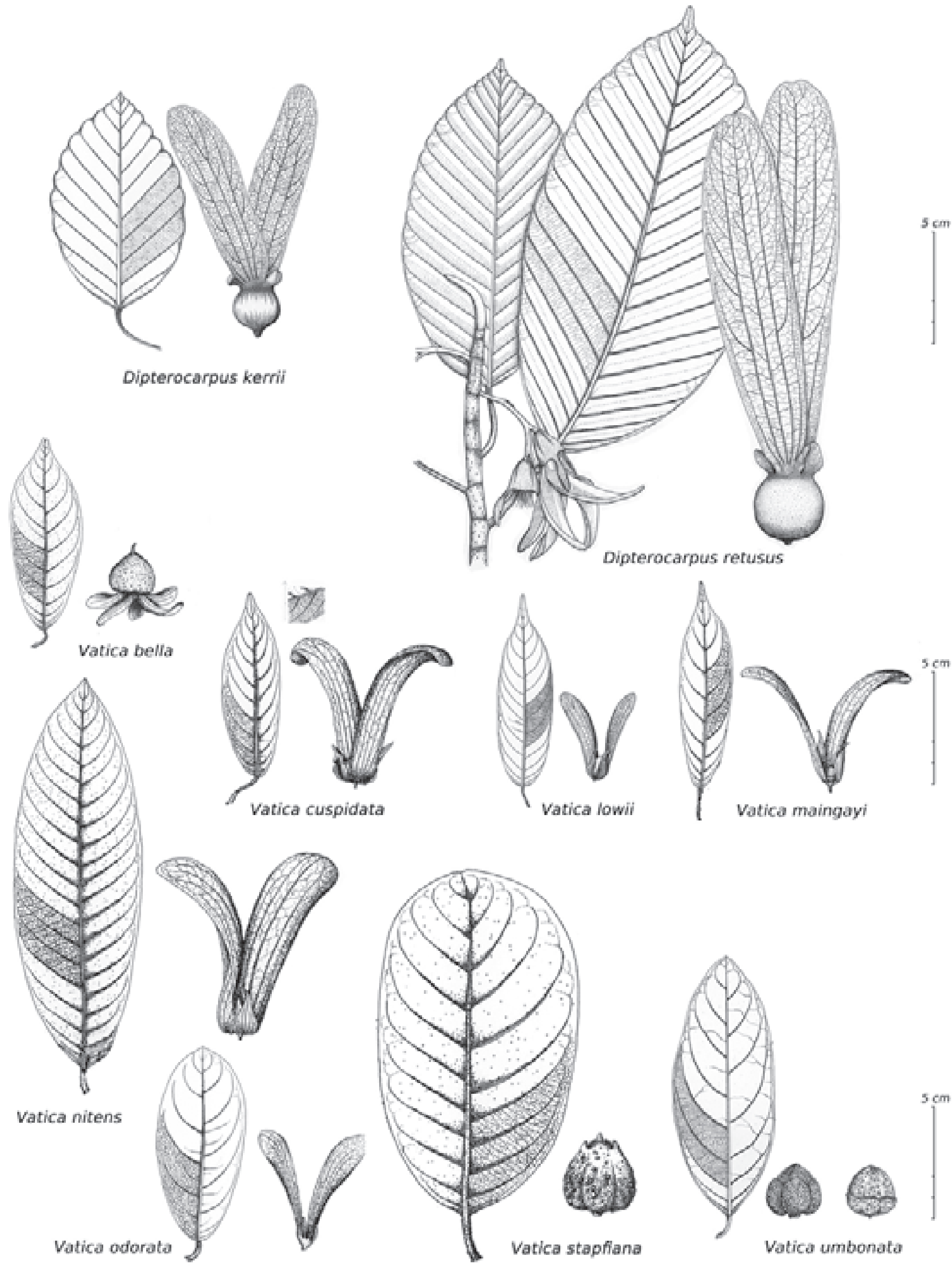

Figure 17. Species of *Dipterocarpus* and *Vatica* in the Hala-Bala forest complex: leaves and fruits.

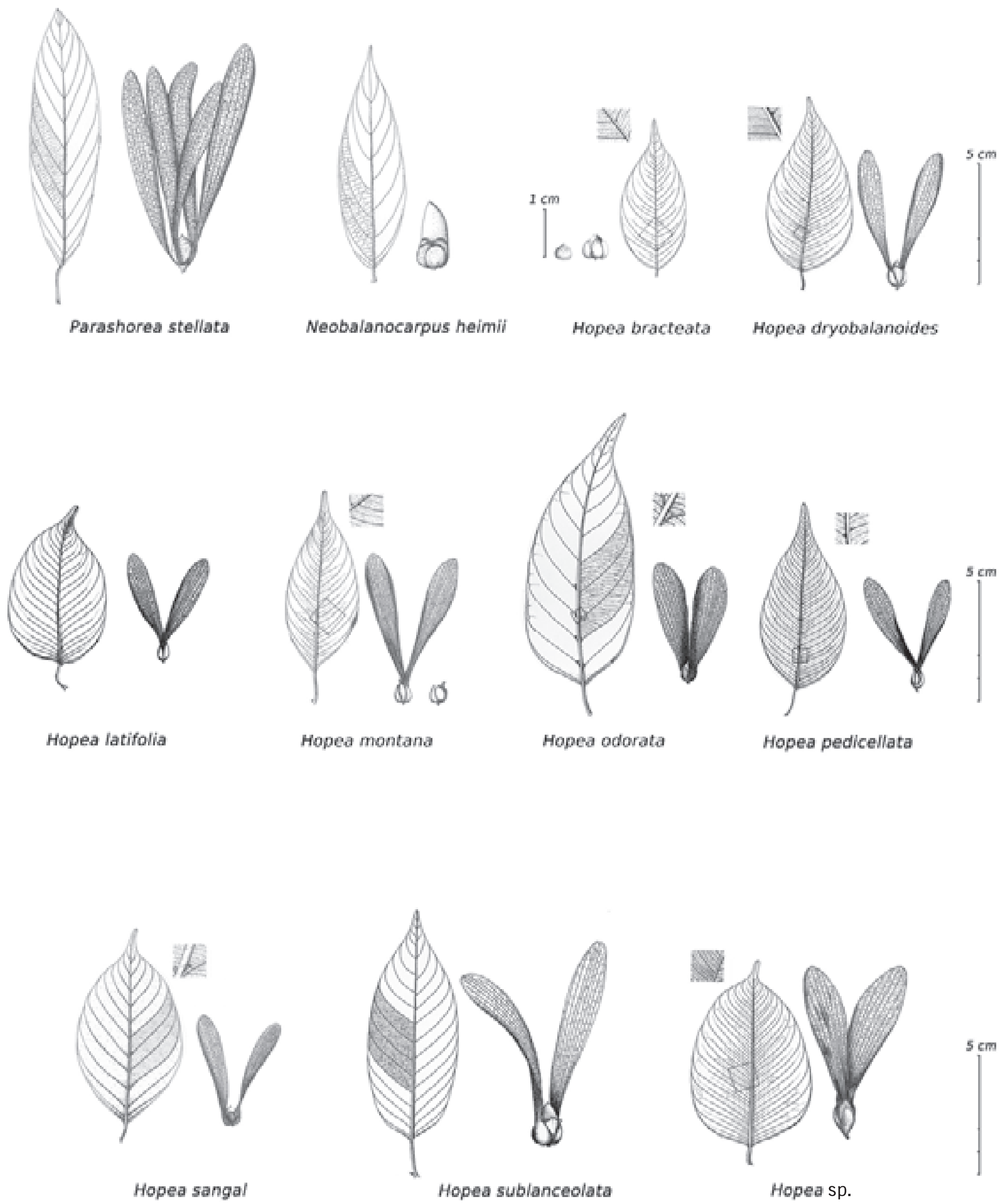

Figure 18. Species of *Parashorea*, *Neobalanocarpus* and *Hopea* in the Hala-Bala forest complex: leaves and fruits.

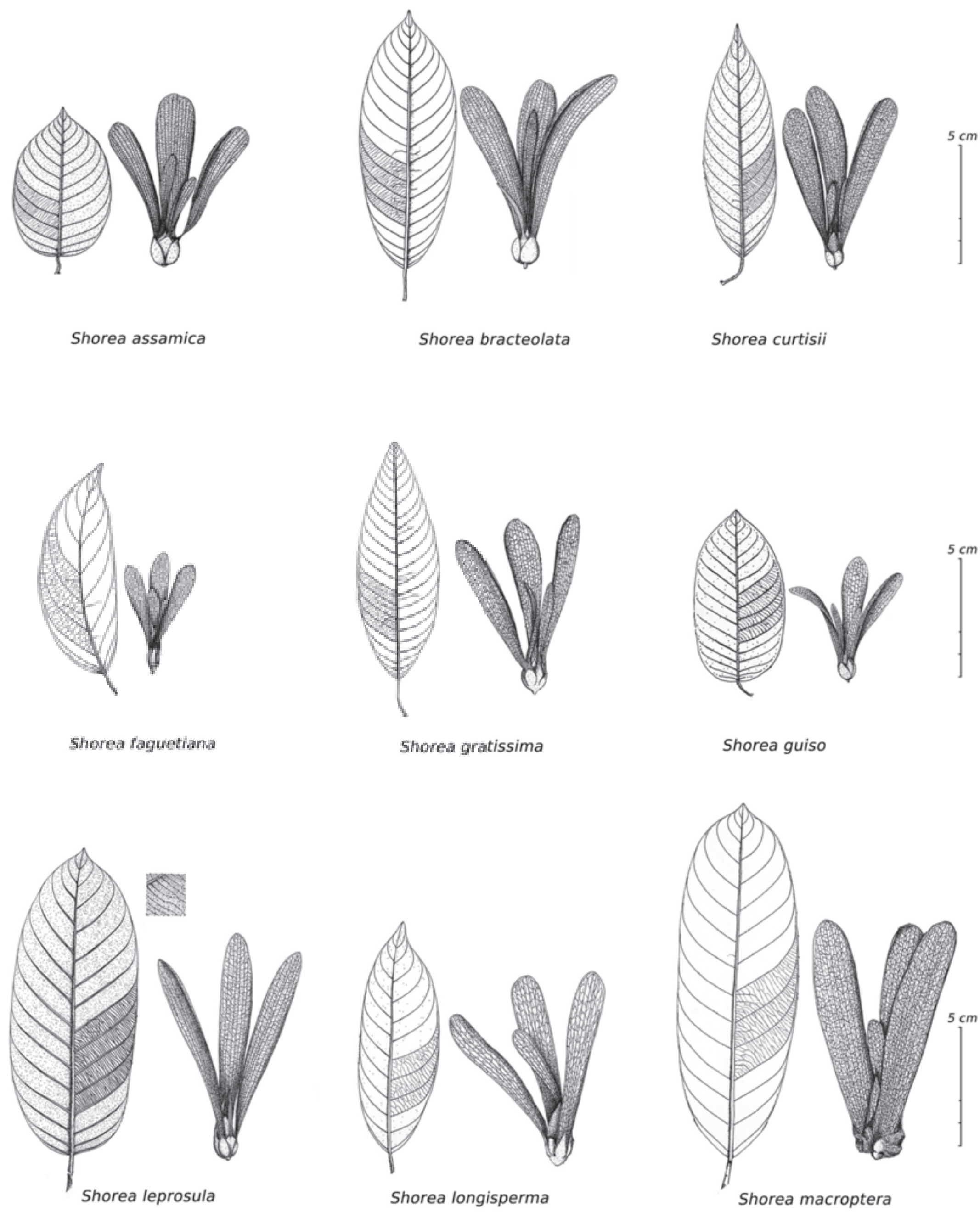

Figure 19. Species of *Shorea* in the Hala-Bala forest complex: leaves and fruits.

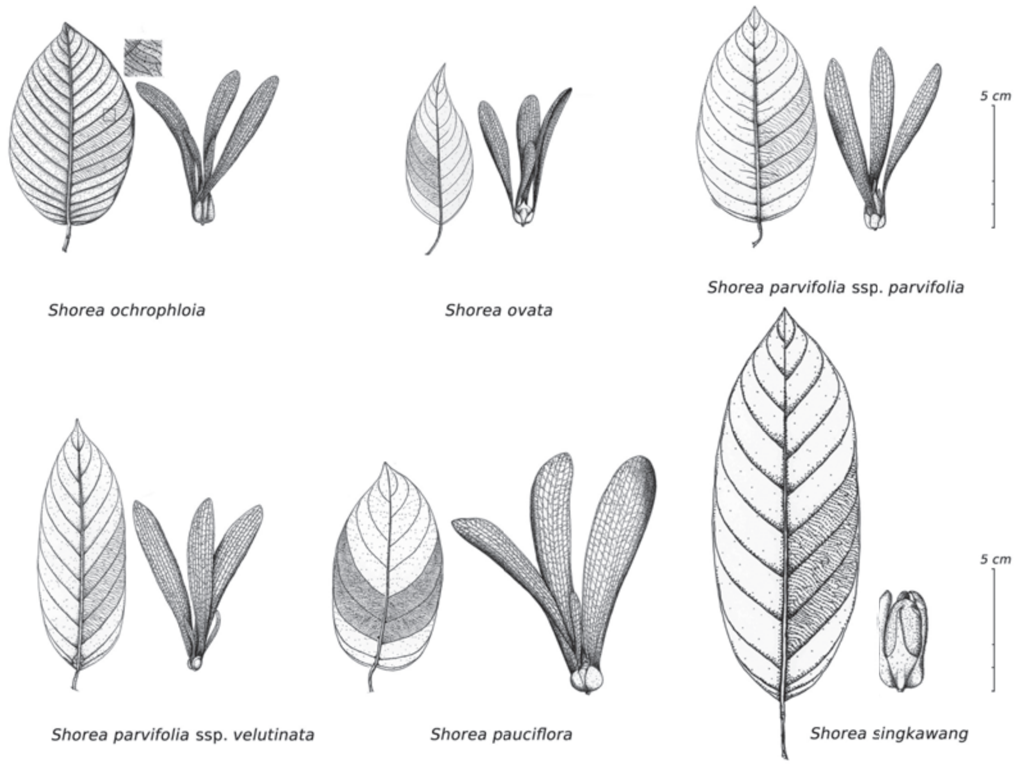

Figure 20. Species of *Shorea* in the Hala-Bala forest complex: leaves and fruits.

Figure 21. *Anisoptera laevis* Ridl.: A. infructescence; *Dipterocarpus acutangulus* Vesque: B. fruit; *D. crinitus* Dyer: C. stipular shoot and leaves, D. fruit.

Figure 22. *Vatica bella* Slooten: A. fruit; *V. nitens* King: B. infructescences; *V. stapfiana* (King) Slooten: C. fruit; *V. umbonata* (Hook.f.) Burck: D. fruit.

Figure 23. *Vatica maingayi* Dyer: A. inflorescences, B. infructescences; *V. lowii* King: C. fruit; *V. cuspidata* (Ridl.) Symington: D. fruits.

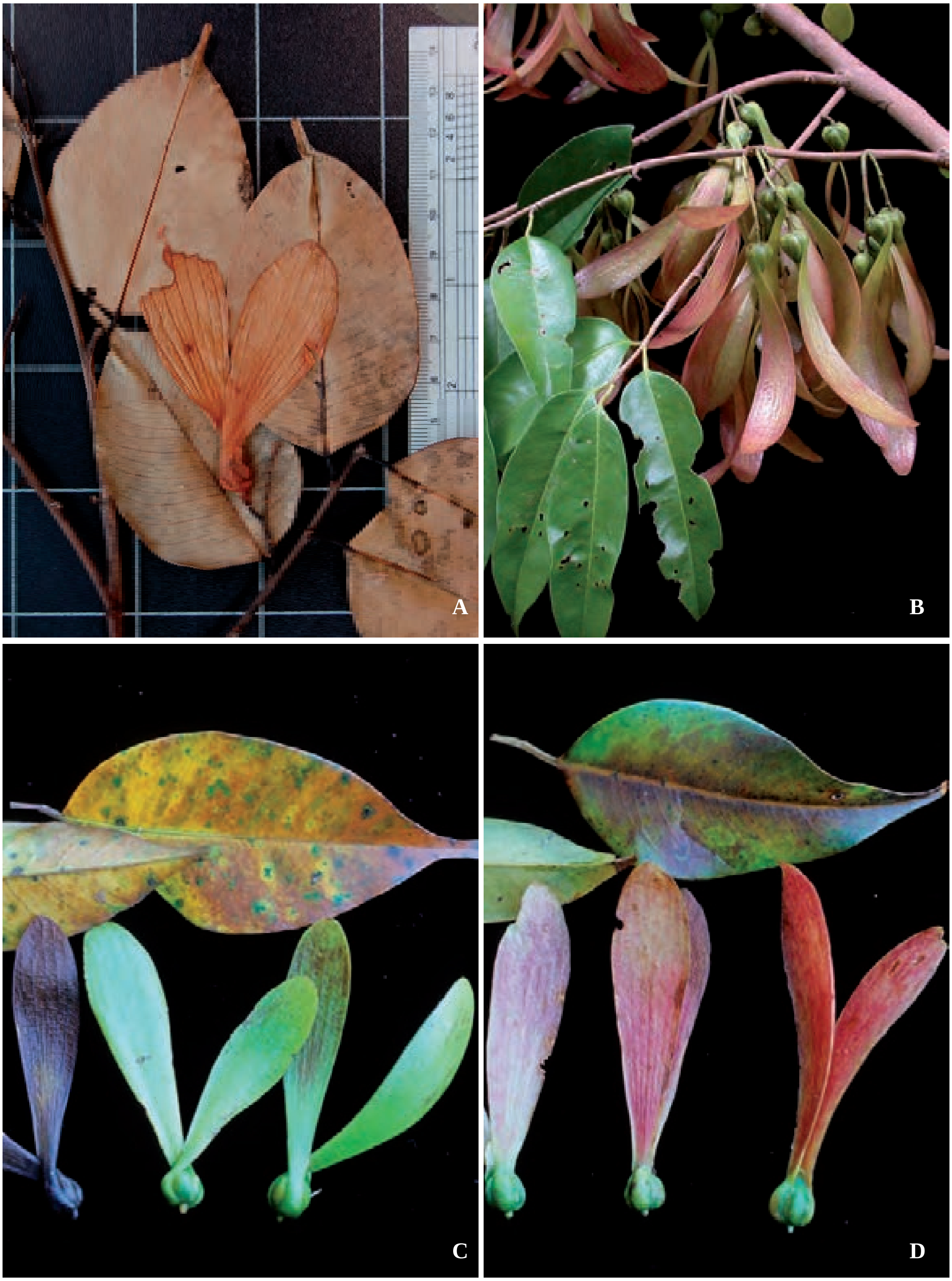

Figure 24. *Hopea* sp.: A. infructescences; *H. sublanceolata* Symington: B. infructescences; *H. dryobalanoides* Miq.: C. leaves & fruits; *H. montana* Symington: D. leaf & fruits.

Figure 25. *Hopea bracteata* Burck: A. fruit; *Shorea pauciflora* King: B. fruit; *S. ochrophloia* Strugnell ex Symington: C. inflorescence, D. infructescence.

Figure 26. *Shorea parviflora* ssp. *velutinata* P.S. Ashton: A. infructescences; *S. ovata* Dyer ex Brandis: B. fruits; *S. longisperma* Roxb.: C. infructescence; *S. bracteolata* Dyer: D. infructescence.