



Three new species of *Ventilago* (Rhamnaceae) from South-East Asia

DANIEL CAHEN^{1,2} & TIMOTHY M.A. UTTERIDGE²

¹Université de Strasbourg, Life Sciences Faculty, 28 rue Goethe, 67083 Strasbourg, France.

²Royal Botanic Gardens, Kew, Herbarium, Kew, Richmond, Surrey, TW9 3AE, U.K.

E-mail: d.cahen@kew.org; t.utteridge@kew.org

Abstract

Three new species of *Ventilago* from Malesia are described and illustrated here: *V. crenata* from New Guinea, *V. ferruginea* from Borneo, Singapore and Sumatra and *V. flavovirens* from Borneo. The morphology of *V. dichotoma*, *V. ferruginea* and *V. flavovirens* is compared, and a key to the *Ventilago* species of Borneo is presented. An IUCN conservation status assessment is given for each new species.

Key Words: Malesia, *Smythea*, South-East Asia, systematics, taxonomy, tropical climbers, Ventilagineae

Introduction

Ventilago Gaertner (1788: 223) is a genus of ca. 30 species of Old World tropical climbing shrubs, lianas and, rarely, small trees. Members of *Ventilago* are easily recognised by their fruits having an oblong wing-like apical appendage above a conspicuously globose seed chamber (Weberbauer 1895, Suessenguth 1953, Banerjee & Mukherjee 1970). Gaertner's description of the genus was based on specimens from the collection of Joseph Banks and on *Funis viminalis* described by Rumphius (1747: 3, t. 2), and the generic name is very likely a reference to the anemochorous winged fruits. *Ventilago* is closely related to *Smythea* Seemann (1862: 69), a group of 11 species of mostly South-East Asian tropical climbers whose fruits differ in their flattened and elongated seed chamber (Weberbauer 1895, Suessenguth 1953, Banerjee & Mukherjee 1970, Cahen & Utteridge, in press). *Ventilago* and *Smythea* are the only members of tribe *Ventilagineae* J.D. Hooker (1862), unique in Rhamnaceae in its members' fruits having a pronounced apical appendage. *Ventilago* and *Smythea* were retained in Ventilagineae after phylogenetic analysis of morphological data in Richardson *et al.* (2000a), and the tribe Ventilagineae, without *Smythea* as it was not sequenced, is retained as a monophyletic group with strong bootstrap support in the strict consensus trees in the analysis of plastid genome *rbcL* and *trnL-F* sequences by Richardson *et al.* (2000b). Richardson *et al.* (2000a) maintain Hooker's Ventilagineae and note that it is unique within the family because of the 'fruits with a pronounced apical appendage'.

Revisions of *Ventilago* at a regional scale have been published in local Floras, notably by Pierre (1894) who reviewed the genus for Cochinchina; King (1896: 378–382), and Ridley (1922: 461–468) for the Malay Peninsula; Pitard (1907–1912) and Tardieu-Blot (1948) for Indochina; Guillaumin (1926) for New Caledonia; Banerjee & Mukherjee (1970) for India and Chen & Schirarend (2007) for China; an enumeration of *Ventilago* species of the Philippines was presented by Merrill (1923). The monographic studies of Rhamnaceae in *Die Natürlichen Pflanzenfamilien* by Weberbauer (1895), and in a later edition Suessenguth (1953), include attempts to review the genus beyond the regional scale.

During a taxonomic study of *Ventilago* and *Smythea* from SE Asia, three new species of *Ventilago* were identified (in addition to several new species of *Smythea* described in a revision of that genus—see Cahen & Utteridge, in press). Specimens from central and south-eastern New Guinea with several morphological differences distinguishing them from hitherto described New Guinean species, are described here as *Ventilago crenata*. Furthermore, we identified two groups of morphologically unique specimens from the Sunda Shelf, and from Sabah in particular, that had been previously determined within a very broad concept of *Ventilago dichotoma* (Blanco 1837: 709) Merrill (1905: 32) despite several characters that clearly differed from the representative specimens cited by Merrill (1909). Consequently, two new *Ventilago* species from Borneo are described: *Ventilago ferruginea* and *Ventilago flavovirens*. A table comparing

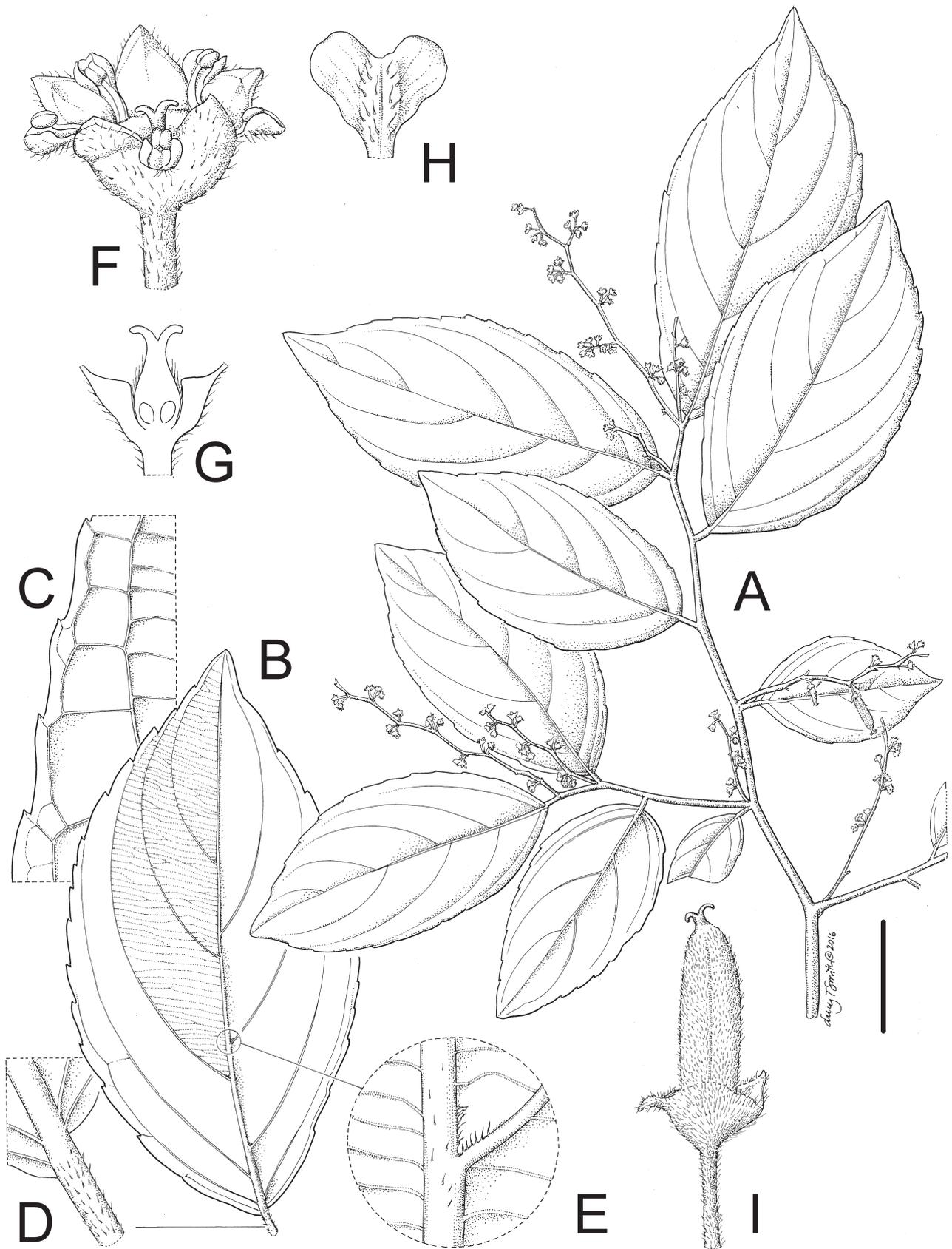


FIGURE 1. *Ventilago crenata*. **A** habit. **B** leaf, abaxial view. **C** detail of marginal venation pattern, abaxial view. **D** detail of asymmetric leaf base, abaxial view. **E** detail of abaxial midrib showing domatia. **F** flower. **G** flower, longitudinal section. **H** petal, abaxial view. **I** immature fruit. Scale bar: **A** = 3 cm; **B** = 2 cm; **C**, **D** = 5 mm; **E**, **F**, **G** = 2 mm; **H** = 1 mm; **I** = 4 mm. All from Pullen 5672. DRAWN BY LUCY T. SMITH.

the morphology of these newly identified species and of *V. dichotoma*, as well as a key to the Bornean species of *Ventilago* are provided here because of the large number of misidentified specimens from Borneo. The new species described from New Guinea brings the number of *Ventilago* species from that island to three, all of which have a combination of unique characters for identification as discussed below.

Materials and methods

Herbarium specimens from A, E, GH, K, KEP and L were used for study and measurements. An exclamation mark (!) is used to show that a specimen has been seen. Leaf anatomy terms are from Hickey (1979) and other morphology terms follow Beentje (2010). Habitat descriptions were based on the Terrestrial Ecoregions of the World map (Olson *et al.* 2001). Specimens were georeferenced using the point-radius method (Wieczorek *et al.* 2004). For conservation assessments, IUCN Red List categories and criteria were applied (IUCN 2012), following IUCN guidelines (IUCN Standards and Petitions Subcommittee 2016) and using GeoCat (Bachman *et al.* 2011) to calculate Extent Of Occurrence (EOO) and Area Of Occupancy (AOO) metrics. Protected areas were located using the World Database on Protected Areas online interface (IUCN and UNEP-WCMC 2016).

Taxonomy

Ventilago crenata Cahen & Utteridge *sp. nov.*, Fig. 1

Ventilago crenata is related to *Ventilago microcarpa* K.Schum. in Schumann & Hollrung (1889: 72) and *Ventilago papuana* Merrill & Perry (1941: 263), but differs in its leaves, which have crenate margins, fewer secondary veins that are more elevated abaxially, a shorter petiole and tufts of hairs in secondary vein axils. The species also differs in its flowers, whose nectary disks are glabrous.

Type:—PAPUA NEW GUINEA. Northern Division [Oro Prov.]: Pongani valley near Dareki village, Managalese area, Rain forest on broken lava slope, ca. 2100 feet [650 m], 13 August 1964, Pullen 5672 (holotype: L!; isotypes: GH!, LAE n.v.).

Climber, woody. *Indumentum* sparse at base of branchlets, dense at distal end of branchlets; hairs cinereous to fulvous, spreading to appressed-antrorse. *Branches* slender, terete, smooth, reddish-brown; branchlets ridged. *Stipules* fugaceous. *Leaves* with lamina narrow ovate to elliptic, 5.1–10.8 cm long, 2.4–5.0 cm wide, chartaceous-subcoriaceous, slightly shiny adaxially, abaxial lamina bearing small rounded glandular spots, apex slightly attenuate to rounded, blunt to mucronulate, base usually asymmetric, rounded to widely cuneate, margins irregularly crenate, apical end of crenations tipped with a minute callosity; primary vein abaxially sparsely hairy, elevated and drying with a red colour; secondary veins 4–6 pairs, decurrent along the primary vein, abaxially sparsely hairy, elevated, unbranched and remaining separate, tertiary veins perpendicular to the primary vein, most spaced by c. 0.5 mm from each other, forming distinct horizontal lines on both sides of lamina, higher order venation reticulations distinct; domatia present, tufts of hairs in secondary vein axils; petiole 2–7 mm long, sulcate, hairy. *Inflorescence* fascicles with the leaves bearing them fugaceous so that fascicles are arranged in racemes or panicles with racemes to ca. 7 cm long at young fruiting stage, raceme rachis ca. 0.9 mm wide at base. *Flowers* pedicellate with a hypanthium ca. 1.1 mm wide, bisexual, 5-merous, perigynous; sepal lobes triangular, adaxially keeled with an apical protuberance; petals present, clawed, hairy abaxially, obcordate, each enclosing a stamen before anthesis; androecium apostemonous, anthers 5, dorsifixed, introrse; disk subpentagonal, filling the hypanthium, fleshy, glabrous, yellow; ovary hairy, half-immersed in disk, locules 2; style 2-fid. *Fruit* densely hairy when young, apex with style remains persistent, divergent and recurved.

Distribution:—New Guinea (Central, Oro and Southern Highlands Provinces) (Fig. 2).

Habitat:—New Guinea Central Range montane rain forests and south-eastern Papuan rain forests; elev. 30–800 m.

Conservation status:—Near Threatened (NT). Given that only three localities are known for the taxon, it meets the AOO requirements under criterion B for threatened. Also, based on the data available, the taxon's distribution is severely fragmented. However, its EOO is greater than 29,000 km², and a relatively stable conservation status of New Guinean rain forests (Morrison 2001a, 2001b) suggests that the population may not be declining. *Schodde 2418* was collected within Lake Kutubu Wildlife Management Area (IUCN Category not reported). The other two collection localities are not within protected areas.



FIGURE 2. Distribution of *Ventilago crenata* (●).

Phenology:—Collected in flower from August to October.

Etymology:—The specific epithet refers to the leaf's crenate margin.

Discussion:—*Ventilago crenata* is recognised by its irregularly crenate leaf margin, 4–6 pairs of abaxially elevated secondary veins, tufts of hairs in secondary vein axils, 2–7 mm long petiole and glabrous nectary disks. The only other taxa of *Ventilago* found in New Guinea are *V. microcarpa*, and *V. papuana*, which have entire leaf margins, 6–8 pairs of secondary veins that are almost flat abaxially, no domatia at secondary vein axils, a 5–13 mm long petiole and hairy nectary disks. *Ventilago microcarpa* and *V. papuana* can be recognised on the leaf size with *V. microcarpa* having leaves to 7 cm long on petioles up to 6 mm long, with *V. papuana* having leaves to 12 cm long on longer petioles 6–9 mm long.

The specimen collected at a low elevation (ca. 30 m) on alluvium near the Mori River (*Pullen 8188*) differs from the type specimen and *Schodde 2418* collected at 650–800 m in its narrower leaves with almost entire leaf margins and long and much-branched panicles. However, its morphology is clearly more similar to that of *V. crenata* than it is to that of *V. microcarpa* and *V. papuana*, in particular this specimen has 4–6 pairs of elevated secondary veins, short petioles and glabrous yellow nectary disks.

Of the specimens currently available for study, winged fruits can be observed only on *Pullen 5672*. However, they are at an early development stage, and the characteristic *Ventilago* globose seed chamber in the fruit's lower portion could not be observed with the material available for study. If mature fruits bear an inconspicuous, flat and elongated seed chamber, *V. crenata* would in fact be a member of *Smythea*. However, the presence of flower fascicles in leafless racemes and the absence of papillae on nectary disks suggest that *V. crenata* is a member of *Ventilago*.

Additional specimens examined:—PAPUA NEW GUINEA. Central Province: Mori River, c. 15 km NE of Cape Rodney, rain-forest on alluvium, 10°04' N 148°32' E, ca. 30 m, 1 September 1969, *Pullen 8188* (L!). Southern Highlands Province: Lake Kutubu, near Moro, primary forest; ca. 2700 feet [800 m], 6 October 1961, *Schodde 2418* (GH!, L!).

***Ventilago ferruginea* Cahen & Utteridge, sp. nov., Fig. 3**

Ventilago ferruginea is related to *V. flavovirens* but differs in its leaves often drying with a rusty-brown colour, often longer petioles, more or less symmetric leaf base, more pairs of more conspicuously elevated secondary veins and in its closer tertiary veins not readily felt by touch on the abaxial leaf lamina.

Type:—MALAYSIA. Sabah: Kalabakan, Hap Seng km 12, 24 May 1982, *Fedilis Krispinus SAN 94823* (holotype: K!; isotypes: KEP!, L!, SAN n.v., SAR n.v., SING n.v.).

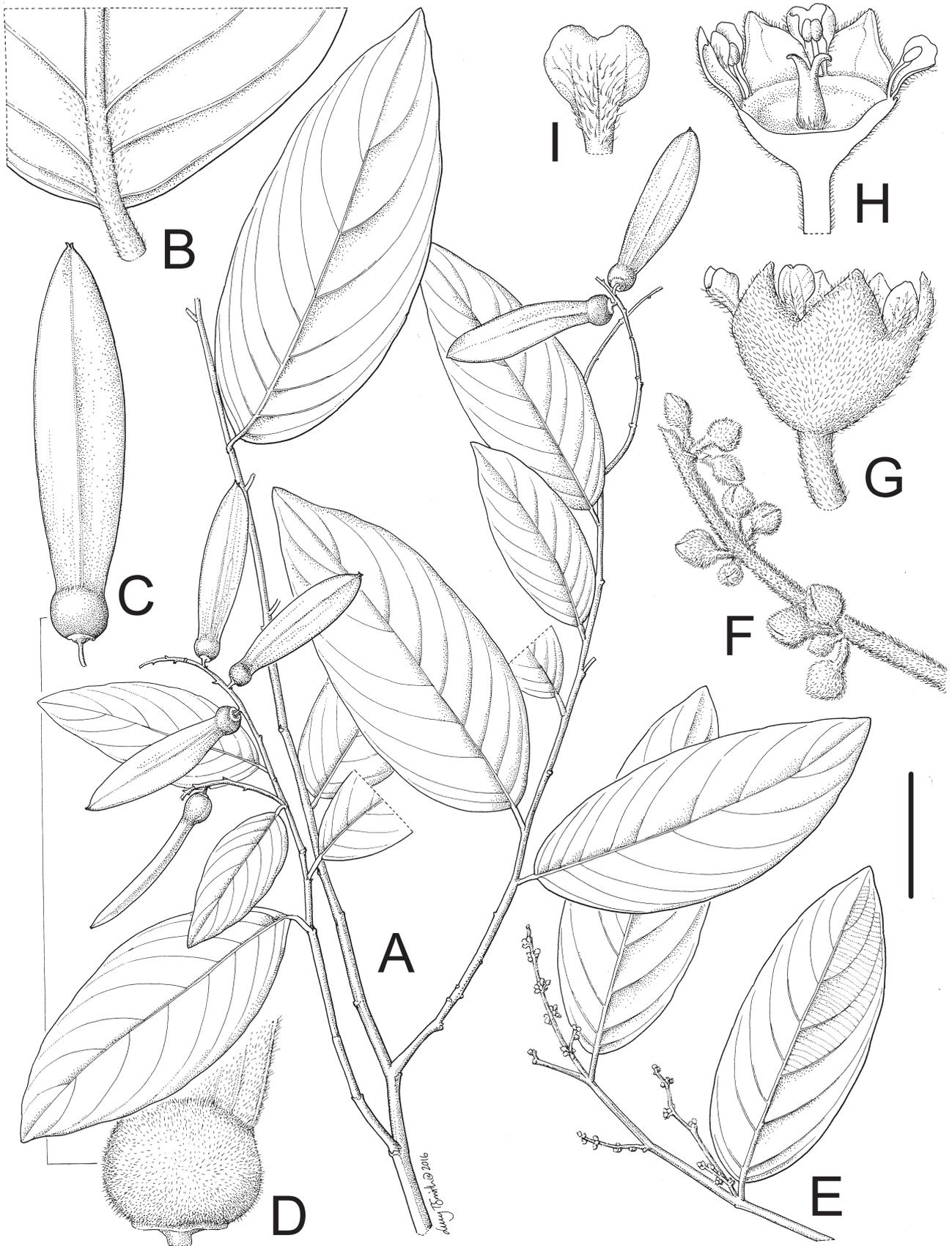


FIGURE 3. *Ventilago ferruginea*. **A** habit. **B** detail of leaf base, abaxial view. **C** fruit. **D** detail of fruit base showing indumentum. **E** inflorescence branch. **F** detail of distal portion of inflorescence branch showing flower buds. **G** flower. **H** flower, longitudinal section. **I** petal, abaxial view. Scale bar: **A, E** = 3 cm; **B** = 5 mm; **C** = 1.5 cm; **D, F** = 4 mm; **G, H** = 1.6 mm; **I** = 1 mm. **A–D** from *Fedilis Krispinus* SAN 94823; **E** from *Madani et al.* 107609; **F–I** from *Au S.* 23925. DRAWN BY LUCY T. SMITH.

Climber, woody, up to 18 m long. *Indumentum* sparse at base of branchlets, dense at distal end of branchlets, very dense on inflorescence rachis, often completely hiding its surface; hairs fulvous, spreading to appressed-antrorse. *Branches* slender, terete, smooth; branchlets often deeply ridged. *Stipules* fugaceous, deltoid to subulate. *Leaves* with lamina narrow ovate-elliptic to oblong, often asymmetrical, 6.5–22.0 cm long, 2.2–7.5 cm wide, subcoriaceous, often rusty brown when dry, adaxially shiny and glabrous to hairy, especially along veins, smooth but with higher order venation reticulations readily felt by touch, abaxially dull and soft to touch with higher order venation reticulations not readily felt by touch, often hairy, if so, then sparsely to very densely covered with fulvous hairs, at least near base, apex attenuate to rounded, blunt to mucronulate, base more or less symmetric, obtuse to subcordate, margins entire, obscurely repand with sometimes a minute black callosity on undulation lobes; primary vein abaxially sparsely to densely hairy, ridged and conspicuously elevated; secondary veins [6–]8–10[–12] pairs, brownish when dry, often decurrent along the primary vein, at least abaxially sparsely to densely hairy, conspicuously elevated abaxially, unbranched and remaining separate, tertiary veins perpendicular to the primary vein, most spaced by c. 0.5 mm from each other, forming distinct horizontal lines on the adaxial lamina surface, higher order venation reticulations distinct; domatia absent; petiole length variable even on the same branchlet 3–13 mm long, sulcate, sparsely to very densely hairy. *Inflorescence* fascicles with the leaves bearing them fugaceous so that fascicles are arranged in racemes or panicles with racemes to ca. 15 cm long, raceme rachis ca. 0.9 mm wide at base. *Flowers* pedicellate with a hypanthium ca. 1.1 mm wide, bisexual, 5-merous, perigynous; sepal lobes triangular, adaxially keeled with an apical protuberance; petals present, clawed, hairy abaxially, obcordate, each enclosing a stamen before anthesis; androecium apostemonous, anthers 5, dorsifixed, introrse; disk subpentagonal, filling the hypanthium, fleshy, glabrous; ovary hairy, half-immersed in disk, locules 2; style 2-fid. *Fruit* densely hairy, reddish-brown, with a conspicuous, globose basal portion enclosing the seed chamber and a distinct wing-like apical appendage, oblong, to 7 cm long and 1.5 cm wide at maturity; apex acute to rounded with style remains forming a distinct mucro; persistent calyx annular, attached at base of globose part of fruit.

Distribution:—Borneo (East Kalimantan, Sabah and Sarawak), Singapore and Sumatra (Fig. 4).

Habitat:—Bornean, southern Peninsular Malaysian and Sumatran rain forests; elev. 0–1300 m.

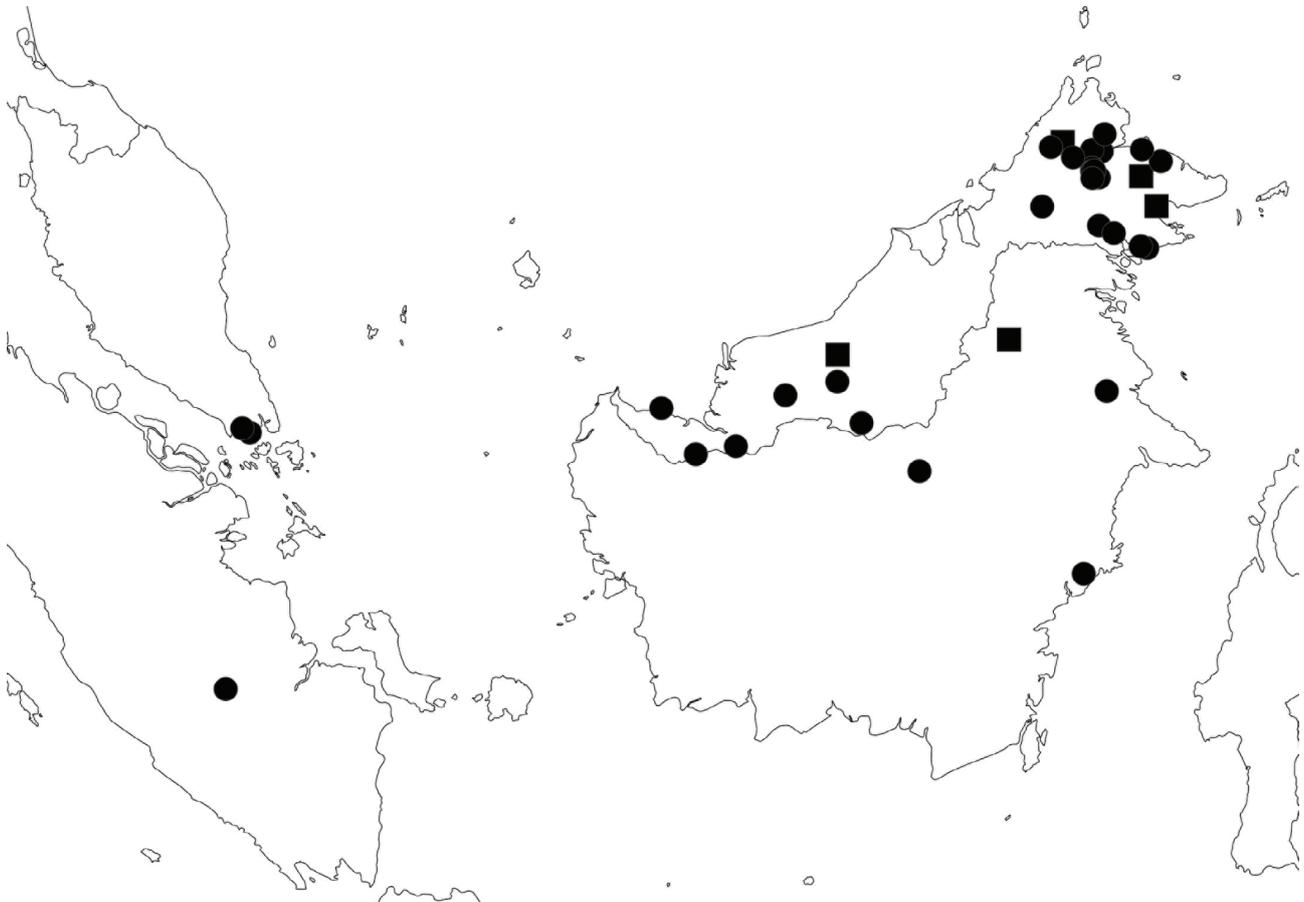


FIGURE 4. Distribution of *Ventilago ferruginea* (●) and *V. flavovirens* (■).

Conservation status:—Near Threatened (NT). It is very likely that the taxon is declining and is severely fragmented given widespread destruction of the lowland rainforests of Borneo, the Malay Peninsula and Sumatra (Loucks 2001a, Loucks 2001b, Loucks & Whitten 2001). However, the taxon is distributed with an EEO much greater than 30,000 km². Also, some specimens were collected in protected areas, and the populations there might not be declining: Bidu-Bidu Protection Forest Reserve (IUCN Category Ia), Sungai Imbak Virgin Jungle Reserve (IUCN Category Ia), Kabili Sepilok Virgin Jungle Reserve (IUCN Category Not Reported) and Tawai Protection Forest Reserve (IUCN Category Ia) in Sabah, Santubong National Park (IUCN Category Not Reported) in Sarawak and Central Catchment Nature Reserve (IUCN Category Ib) in Singapore.

Phenology:—Collected in flower in March, May, June and September to December. Collected in fruit from May to December.

Etymology:—The specific epithet refers to the leaves drying rusty-brown.

Discussion:—*Ventilago ferruginea* is recognised by its [6–]8–10[–12] pairs of abaxially conspicuously elevated secondary veins, abaxial leaf lamina often with orange-brown (ginger) coloured hairs, petiole 3–13 mm long, very dense hairs often completely hiding the inflorescence rachis surface, densely hairy fruits and persistent calyx forming a ring at the base of the fruit. Besides *V. flavovirens*, the other taxa of *Ventilago* found in Borneo are *V. borneensis* Ridley (1931: 493), *V. dichotoma* and *V. malaccensis* Ridley (1917: 22). *Ventilago ferruginea* differs from *V. borneensis* in its more numerous and more conspicuously elevated abaxial secondary veins and longer and more coriaceous fruit wing, from *V. dichotoma* in its subcoriaceous leaves, longer petioles, more conspicuously elevated secondary veins and hairy fruit (Table 1) and from *V. malaccensis* in the absence of domatia, in its entire to obscurely repand leaf margins, hairy fruits and persistent calyx forming a ring at the base of the fruit. In Sumatra, other members of *Ventilago* are *V. lucens* Miquel (1860: 330) and *V. malaccensis*. *Ventilago ferruginea* differs from *V. lucens* by the same characters as it does from *V. dichotoma*. The only other taxon of *Ventilago* found in Singapore is *V. malaccensis*.

TABLE 1. Morphological comparison between *Ventilago dichotoma*, *V. ferruginea* and *V. flavovirens*.

Characters	<i>V. dichotoma</i>	<i>V. ferruginea</i>	<i>V. flavovirens</i>
Leaf drying colour	often copper brown	often rusty brown	yellowish green
Petiole length	2.0–4.0 mm long	3.0–13.0 mm long	0.5–4.0 mm long
Leaf base	symmetric	more or less symmetric	slightly asymmetric
Venation drying colour	reddish	brownish	yellowish-green
Primary vein indumentum	often hairy abaxially	hairy at least abaxially	glabrous
Secondary veins	8–11[–13] pairs	[6–]8–10[–12] pairs	6–9[–11] pairs
Secondary vein position	weakly to moderately elevated	conspicuously elevated	weakly to moderately elevated
Leaf abaxial surface	glabrous	often hairy	glabrous
Leaf texture	chartaceous	subcoriaceous	subcoriaceous
Inflorescence rachis	visible beneath hairs	hidden by hairs	hidden by hairs
Fruit surface	glabrous	hairy	hairy

Additional specimens examined:—INDONESIA. East Kalimantan: Bloe-oe, 50 m, 1896–1897, *Jehari* 1413 (L!); W. Koetai, no.19, L. Poehoes, ca. 100 m, 13 November 1925, *Endert* 4853 (K!, L!); Berau Inhutani area, km 16, trayek D [2°00'N 117°23'E], 50 m, 15 October 1997, *Arifin et al. Berau* 915 (GH!, K!, L!); Central Kutei, Belajan R. near Long Ble, 25 March 1955, *Kostermans* 10.240 (GH!, K!, L!). Sumatra [South Sumatra Upper Musi Region]: 1881–1882, *Forbes* 3042 (GH!, K!, L!). MALAYSIA. Sabah: Beluran, Bidu-Bidu F.R., logged area, 20 July 1990, *Madani SAN* 128861 (E!, K!, KEP!); Bidu-Bidu hill [5°50'N 117°18'E], 30 July 1990, *Maikin & Francis SAN* 130669 (K!); Sg.Meliau, 28 July 1983, *Sigin & Rahim SAN* 99681 (K!, L!); Tungud Beluran, 2 August 1983, *Sigin et al. SAN* 99793 (E!, KEP!); Kalabakan, Hap Seng logged area, mile 12, on hill top, 5 June 1982, *Fedilis SAN* 94683 (K!); Hap Seng km 12, 27 May 1982, *Krispinus SAN* 94836 (K! KEP!, L!); 5 June 1982, *Krispinus SAN* 94863 (KEP!, L!); Seranum Gunung Rara F. Res., unlogged area, 21 June 1983, *Fedilis & Sumbing SAN* 96094 (K!, L!); Keningau, Pinangah Forest Reserve, 26 September 1985, *Fidilis SAN* 110303 (K!, L!); Ulu sg. Matud, 22 June 1987, *Fidilis & Shawan SAN* 119523 (K!, KEP!); Labuk/Sugut, Sg. Kiboriki, 8 July 1983, *Gibot SAN* 97599 (K!, L!); Nabawan, Labou F. Res. [4°19'N 117°55'E], 22 May 1992, *Mantor SAN* 129985 (K!, KEP!); Ranau, About 2 miles NW of Kampung Pinawantai [5°53'45"N 116°29'45"E], 2,000 ft [600 m], 7 May 1973, *Shea & Aban SAN* 76781 (K!, L!); Sandakan, Mile 110 Telupid Ranau Road, 300 ft [100 m], 15 August 1978, *Madani SAN* 89207, (K!, KEP!, L!); Sepilok Forest Reserve [5°6'N 117°56'E], 400 ft [100 m], 23 November 1956, *Agama & Kapis bin Sisiron SAN* 17263 (K!, KEP!, L!); Ulu Sungai Kun-Kun [5°31'N 117°11'E], 13 December 1984, *Madani et al. SAN* 107609 (K!, L!); Sungai Kun Kun, 13

June 1983, *Gibot SAN 97124* (L!); Tengkulap Forest Reserve, 1 December 1985, *Suin & Matin SAN 111752* (K!, L!); Tawau, Beradaya Road [4°17'N 118°1'E], 20 December 1963, *Gibot SAN 33004* (K!, L!); Chain 31. Jalan Bambang, Tg. F.R., 150 ft [50 m], 5 June 1964, *Pereira 43730* (K!, L!); Mile 27 Sepulot Road, Luasong, 17 July 1979, *Krispinus SAN 89847* (K!, KEP!, L!); Telupid, Bukit Tangkunan Forest Reserve, 400 m, 6 June 1992, *Meijer & Madani SAN 131866* (GH!); Bukit Tawai Keramuak, 14 March 1985, *Sundaling & Tuyok SAN 108441* (K!, KEP!, L!); Tongod, Sg. Binalik, Keramuak, 13 June 1983, *Sundaling SAN 96977* (K!, KEP!, L!); Sg. Binalik, Keramuak, 400 m, 13 June 1983, *Sundaling SAN 96989* (K!, KEP!, L!). Sarawak: 2nd Division, Simanggang, Bayai [1°7'45"N 111°30'45"E], 9 December 1985, *Paie & Munting S.51514* (K!, KEP!, L!); 3rd Division, Kapit, Bkt. Raya [2°9'30"N 113°7'E], 700 ft [200 m], 21 October 1965, *Au S.23925* (GH!, K!, KEP!, L!); 7th Division Kapit, Menyiong, Bukit Pendam, 1300 m, 22 November 1979, *Ismawi et al. S. 41555* (K!, L!); Menyiong, Ulu Balleh [1°56'30"N 112°17'45"E], 500 m, 7 November 1979, *Ismawi 41286* (K!, KEP!, L!); Kuching, Santubong [1°44'N 110°20'E], 25 December 1957, *Paie 8964* (K!, L!); Sabal Forest Reserve, 90 km Kuching/Sri Aman Road [1°0'N 110°53'E], 14 September 1994, *Yii Puan Ching et al. S. 67570* (KEP!). SINGAPORE. About 1/2 ml. S.W. of R.A.F. Yacht Club Building, Namazie Estate [1°25'N 103°42'E], 25 April 1953, *Sinclair Singapore Field No. 39591* (E!, L!); North side of MacRitchie Reservoir Singapore [1°20'45"N 103°49'15"E], 12 November 1951, *Sinclair Singapore Field No. 39428* (E!, L!).

Ventilago flavovirens Cahen & Utteridge, *sp. nov.*, (Fig. 5)

Ventilago flavovirens is related to *V. ferruginea*, but differs in its completely glabrous leaves drying yellowish green, usually shorter petioles, asymmetric leaf base and fewer pairs of more weakly elevated secondary veins.

Type:—MALAYSIA. Sabah: Ranau, Kilimu, Cultivated area, 27 August 1987, *Mansus et al. SAN 122269* (holotype: K!; isotypes: E!, KEP!, SAN n.v.).

Climber, woody, to 40 m long. *Indumentum* sparse at base of branchlets, dense at distal end of branchlets, very dense on inflorescence rachis, often completely hiding its surface; hairs short, cinereous to fulvous, spreading to appressed-antrorse. *Branches* slender, terete, smooth; branchlets often deeply ridged. *Stipules* fugaceous, deltoid to subulate. *Leaves* with lamina [narrow] ovate-elliptic to [narrow] oblong, often asymmetrical, 4.5–17.0 cm long, 2.0–6.1 cm wide, subcoriaceous, drying yellowish green, adaxially shiny, abaxially duller, both sides glabrous and smooth but with higher order venation reticulations readily felt by touch, apex attenuate to rounded, often slightly retuse, base slightly asymmetric, obtuse-rounded to slightly cordate, margins entire, to minutely and irregularly crenate-dentate with a minute black callosity on serration tips; primary vein glabrous, abaxially ridged and conspicuously elevated; secondary veins 6–9[–11] pairs, yellowish-green when dry, often decurrent along the primary vein, glabrous, weakly to moderately elevated abaxially, unbranched and remaining separate, tertiary veins perpendicular to the primary vein, most spaced by c. 1.0 mm from each other, forming distinct horizontal lines on the adaxial lamina surface, higher order venation reticulations distinct; domatia absent; petiole 0.5–4.0 mm long, sulcate, [sub-] glabrous. *Inflorescence* fascicles with the leaves bearing them fugaceous so that fascicles are arranged in racemes or panicles with racemes to ca. 10 cm long, raceme rachis ca. 0.9 mm wide at base. *Flowers* pedicellate with a hypanthium, bisexual, 5-merous, perigynous; sepal lobes triangular, adaxially keeled with an apical protuberance; petals present, clawed, hairy abaxially, obcordate, each enclosing a stamen before anthesis; androecium apostemonous, anthers 5, dorsifixed, introrse; disk subpentagonal, filling the hypanthium, fleshy, glabrous; ovary hairy, half-immersed in disk, locules 2; style 2-fid. *Fruit* densely hairy, reddish-brown, with a conspicuous, globose basal portion enclosing the seed chamber and a distinct wing-like apical appendage, oblong, to 6.5 cm long and 1.2 cm wide at maturity; apex acute to rounded with style remains forming a distinct mucro; persistent calyx annular, attached at base of globose part of fruit.

Distribution:—Borneo (East Kalimantan, Sabah and Sarawak) (Fig. 4).

Habitat:—Bornean rain forests; elev. 200–450 m.

Conservation status:—Near Threatened (NT). It is very likely that the taxon is declining and is severely fragmented given widespread destruction of the lowland rainforests of Borneo (Loucks 2001a). However, the taxon is distributed with an EEO much greater than 30 000 km². In addition, some populations may be protected from decline as *McDonald & Ismail 3530* collected within Kayan Mentarang National Park (IUCN Category II), *Meijer SAN 124388* at Mount Silam within the Sepagaya Virgin Jungle Reserve (IUCN Category Ia) and *Dewol S. & Lideh S. SAN 132494* perhaps within the Pin-Supu Virgin Jungle Reserve (IUCN Category Ia).

Phenology:—Collected in flower in April and June. Collected in fruit from June to September.

Etymology:—The specific epithet refers to the leaf's yellowish green colour when dry.

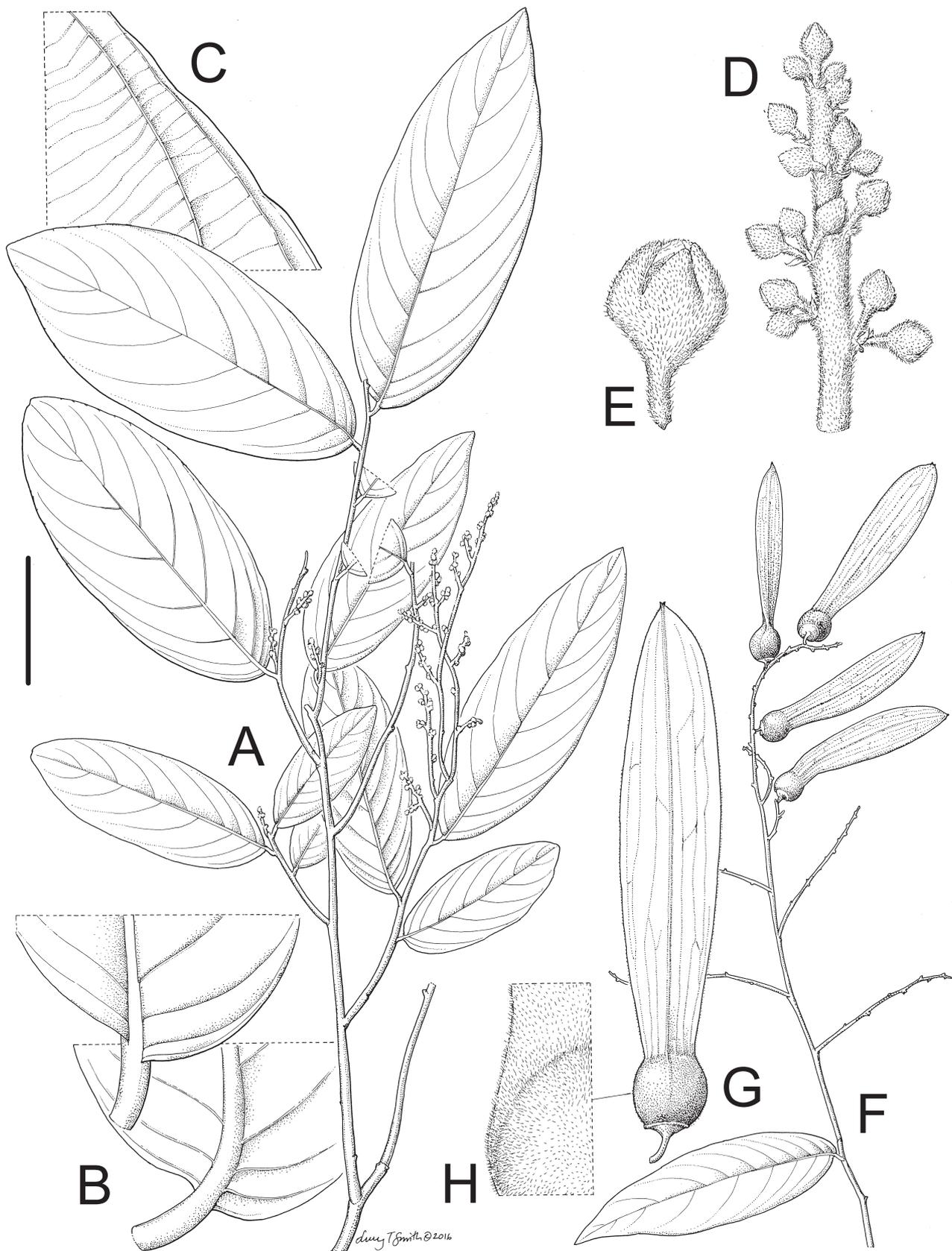


FIGURE 5. *Ventilago flavovirens*. **A** habit. **B** detail of leaf base, abaxial view below, adaxial view above. **C** detail of marginal venation pattern, abaxial view. **D** detail of distal portion of inflorescence branch showing flower buds. **E** detail of flower bud. **F** fruiting branch. **G** fruit. **H** detail of fruit base showing indumentum. Scale bar: **A**, **F** = 3 cm; **B**, **C**, **D** = 4 mm; **E** = 1.6 mm; **G** = 1.5 cm; **H** = 3.3 mm. **A–C** from Dewol S. & Lideh S. SAN 132494; **D**, **E** from Purselglove 5392; **F–H** from Mansus *et al.* SAN 122269. DRAWN BY LUCY T. SMITH.

Discussion:—*Ventilago flavovirens* is recognised by its 6–9[–11] pairs of secondary veins, weakly to moderately elevated abaxially, glabrous leaves, petiole 0.5–4.0 mm long, very dense hairs often completely hiding the inflorescence rachis surface, densely hairy fruits and persistent calyx forming a ring at the base of the fruit. Other taxa of *Ventilago* found in Borneo are *V. borneensis*, *V. dichotoma*, *V. ferruginea* and *V. malaccensis*. *Ventilago flavovirens* differs from *V. borneensis* in its shorter petioles, more numerous secondary veins and longer and more coriaceous fruit wings, from *V. dichotoma* in its subcoriaceous leaves, asymmetric leaf base, abaxially glabrous yellowish-green primary veins and hairy fruits (Table 1) and from *V. malaccensis* in its shorter petioles, glabrous secondary vein axils, hairy fruits and persistent calyx forming a ring at the base of the fruit.

Additional specimens examined:—INDONESIA. North Kalimantan: Kayan-Mentarang Nature Reserve, on Bahau River at or to 3 km above confluence with Gon Biou River towards Long Alango, 2°50'N 115°50'E, 450 m, 7 July 1992, McDonald & Ismail 3530 (L!). MALAYSIA, Sabah: Kota Kinabatangan, Simpan Pin-Supu, 400 m, 13 April 1992, Dewol S. & Lideh S. SAN 132494 (K!, KEP!); Lahad Datu, Mt. Silam, 2 June 1990, Meijer SAN 124388 (K!); Sarawak: Sungei Mayeng, Tau Range, 700 ft [200 m], 6 June 1956, Pursglove P.5392 (GH!, K!, L!).

Key to *Ventilago* species of Borneo

1. Fruit wing glabrous.....2
- Fruit wing hairy3
2. Leaf margin distinctly crenate; secondary veins [4–]5–8 pairs; horizontal tertiary veins spaced from each other on average by ca. 0.3 mm, higher order venation reticulations indistinct; domatia present, tufts of hairs in secondary vein axils. Persistent calyx cup-like, covering about ½ of fruit's globose part..... *Ventilago malaccensis*
- Leaf margin subentire; secondary veins 8–11[–13] pairs; horizontal tertiary veins spaced from each other on average by more than 0.5 mm, higher order venation reticulations distinct; domatia absent. Persistent calyx annular, attached at base of fruit's globose part..... *Ventilago dichotoma*
3. Secondary veins 6–8 pairs, abaxially almost flat; petiole 5–13 mm long. Fruit wings yellowish, chartaceous, to ca. 4 cm long..... *Ventilago borneensis*
- Secondary veins 6–10[–12] pairs, abaxially weakly to conspicuously elevated; petiole 0.5–13 mm long. Fruit wings brownish, subcoriaceous, to ca. 7 cm long.....4
4. Dry leaf often rusty brown; base more or less symmetric; abaxial lamina often hairy; primary vein at least abaxially hairy; secondary veins [6–]8–10[–12] pairs, conspicuously elevated abaxially; petiole 3–13 mm long..... *Ventilago ferruginea*
- Dry leaf yellow-green; base slightly asymmetric; abaxial lamina glabrous; primary vein glabrous; secondary veins 6–9[–11] pairs, weakly to moderately elevated abaxially; petiole 0.5–4 mm long..... *Ventilago flavovirens*

Acknowledgements

We thank the curators and staff of the herbaria that sent material on loan to be studied, the ERASMUS programme for financial support for the first author, Lucy Smith for the illustrations, Heather Lindon at the Plant Names Team at Kew for nomenclatural advice, and the two reviewers and editor for useful comments and suggestions that have improved the manuscript.

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