




Hiding in plain sight: *Nepenthes batik* (Nepenthaceae), an overlooked tropical pitcher plant from Fraser's Hill, Peninsular Malaysia

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Abstract

Nepenthes batik G.Lim, Golos, Mey, Wistuba & A.S.Rob. is described from Fraser's Hill in the Titiwangsa Range of Peninsular Malaysia, where it inhabits montane forests at c. 1300–1500 m elevation. A putative close relative of *N. ramispina* Ridl., the species can be distinguished by its more diminutive overall size, and particularly by consistent differences in phyllode ('lamina') morphology, lower pitcher shape, tendril to pitcher length ratio, spur morphology, and lid gland size and distribution. As a secondary but nonetheless helpful characteristic, all known populations of *N. batik* consistently differ from *N. ramispina* in terms of pitcher colouration. The conservation status and nearest affinities of *N. batik* are assessed, and an updated key to the *Nepenthes* species of the southern Titiwangsa Range provided. Finally, the distribution of *N. ramispina* is clarified based on field observations and a thorough re-examination of existing herbarium material.

Introduction

Nepenthes L. is a genus of carnivorous pitcher plants belonging to the monotypic family Nepenthaceae. It ranges across the tropics of Southeast Asia and includes outlying populations as far west as Madagascar and the Seychelles, and as far east as New Caledonia. Around 200 described species are currently recognised, more than half of which are found in the three main centres of diversity: Borneo, Sumatra, and the Philippines (Clarke *et al.* 2018; McPherson 2023).

The last five years have seen renewed interest in the *Nepenthes* of Peninsular Malaysia, with a number of species described as new (Ghazalli *et al.* 2020, 2022, 2023; Tamizi *et al.* 2020a, 2020b; Golos *et al.* 2023; Lim 2023; Lim *et al.* 2023; Tan *et al.* 2023). Recently, it became clear to the authors that an undescribed *Nepenthes* species was hiding in plain sight within the relatively well-explored region around Fraser's Hill (Bukit Fraser), a hill station popular among tourists.

Officially established as a hill station in 1919, Fraser's Hill covers an area of some 28 km² (Alam *et al.* 2024; Zaini *et al.* 2024). It is situated in the southern Titiwangsa Range (Main Range) in Pahang's Raub district, approximately 60 km north of central Kuala Lumpur (Malaysiana 2013; Rose & Sulaiman 2019). Much of the terrain, including the main built-up area, lies at an elevation of c. 1300 m (where upper dipterocarp and oak–laurel forests

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predominate), rising to 1505 m at its highest point on the double summit of Pine Tree Hill – Twin Peak (which harbours the only extensive patch of ericaceous forest; Kiew 1998; Cheong 2023: 20–22). Fraser's Hill is unusual among Malaysian hill stations for its largely intact forests, having until now been largely spared from overdevelopment (but see Raw 2023), and it is notable for its floral diversity (Kiew 1991, 1992a; Ghani 2010; Go *et al.* 2019). Kiew (1998: 5) recorded 952 indigenous spermatophyte species; an updated checklist encompassing all vascular plants from the region lists 1543 species (Cheong 2023: 12). Fraser's Hill is also famed as a hotspot for birdwatching (Kumari & Ariffin 1989: 10; Strange 2004; Chong & Supari 2010; Davison *et al.* 2019) and for its broader faunal and fungal richness (Latiff *et al.* 2001a; Ghani 2010; Thi *et al.* 2011; Tan & Kamaruddin 2014; Leong *et al.* 2017; Sulaiman & Juhari 2020). These natural attributes have collectively led to it being mooted as a possible state park (Jacobs 2023; Samad *et al.* 2023).

That a popular tourist destination such as Fraser's Hill can yield a pitcher plant species new to science highlights the level of unrecognised diversity present in the montane forests of Peninsular Malaysia. Continued fieldwork across the highlands of the region will doubtless reveal further taxonomic novelties. The description of *Nepenthes batik* G.Lim, Golos, Mey, Wistuba & A.S.Rob. herein brings the total number of recognised *Nepenthes* species from Peninsular Malaysia to 20.

Materials and methods

Field observations of *Nepenthes batik* on Pine Tree Hill and Twin Peak (Titiwangsa Range) were made by the authors on 27 August 2022 and 5 April 2023. Comparative observations of *N. ramispina* Ridl. on Gunung Ulu Kali (1772 m; Titiwangsa Range) were made on numerous occasions between the 1990s and the present time. Additionally, the superficially similar *N. gracillima* Ridl. was observed at its type locality of Gunung Tahan (2187 m; Timur Range) by A. Robinson in 1996 and by the majority of authors at a newly documented locality (Tamizi *et al.* 2020a) in Terengganu in 2024, while *N. sanguinea* Lindl. has been documented by all authors on numerous occasions across the highlands of Peninsular Malaysia.

A comprehensive review of relevant herbarium material was made at KEP, L, and SING herbaria, with further specimens studied at BO, K, P, and SAN (acronyms follow Thiers 2024). Additionally, online scans were consulted of material at A. Owing to the existence of representative voucher specimens and in the interests of minimising disturbance to natural populations, no new herbarium material was collected in relation to this work.

Fine measurements of live *Nepenthes batik* plants on Pine Tree Hill and Twin Peak were made using Vernier callipers and a tape measure. Measurements on herbarium material of small-scale structures such as trichomes were made using a stereomicroscope. Locality data for the distribution map was taken from herbarium records and information gathered from field observations and plotted using SimpleMappr (Shorthouse 2010).

Taxonomic treatment

Nepenthes batik G.Lim, Golos, Mey, Wistuba & A.S.Rob., spec. nov.

Type: MALAYSIA: Pahang: Fraser's Hill, Dairy Farm Rd., forest clearing on path, no elevation data [likely from c. 1000–1300 m; see "Notes on specimens examined"], 31 December 1950, Allen s.n. (holo: SING! [#0094076] [stem with upper pitchers and male inflorescence, second stem with upper pitchers only; identified as *N. gracillima* by J. Sinclair (undated) and as *N. ramispina* by Jebb & Cheek 1997: 78]).

[*N. gracillima* sensu Holttum (1940: 42, second pl. between pp. 41 & 42, top-left fig. [= *N. batik*]) = *N. alba*, *N. batik* & *N. gracillima*]

[*N. ramispina* sensu Jebb & Cheek (1997: 77) = *N. batik*, *N. gracillima*, ?*N. limiana*, *N. ramispina*, *N. sanguinea* & *N. batik* × *N. berbulu*]

[*N. gracillima* × *N. sanguinea* sensu Jebb & Cheek (1997: 99) = *N. batik*]

[*N. gracillima* sensu Kiew (1998: 68, bottom-left fig. on p. 115 [= *N. sanguinea*]) = ?*N. alba*, *N. batik*, *N. gracillima*, ?*N. limiana*, *N. ramispina* & *N. sanguinea*]

[*N. ramispina* sensu Barthlott *et al.* (2004: 154, fig. 132 [= *N. batik*], 2007: 154, fig. 132 & fig. on dust jacket spine [= *N. batik*]) = *N. batik* & *N. ramispina*]

Diagnosis: *Nepenthes batik* differs from *N. ramispina* in having (differences in parentheses) stems 2–4 mm in diameter (4–6 mm in diameter), linear-obovate laminae with narrowly acute to acuminate apices (obovate-oblong laminae with round to broadly acute apices), tendrils longer than pitchers (tendrils shorter than pitchers), spurs apically to basally divided into just 3–4 branches, rarely simple (basally ramified, (3–)4–10 branches), lower pitchers basally ventricose, with hip typically located near midpoint, broadly cylindrical to cylindrical above (narrowly sub-cylindrical throughout, with hip typically located towards lower third of pitcher body), lids typically ovate, glands on lower surface clustered along midline and large, to 0.5 mm in diameter, but sparse and minute, to c. 0.1 mm in diameter, towards margins (typically orbicular, glands more or less uniformly distributed and without significant size increase at midline), and lower and upper pitchers that are yellowish green, heavily speckled with brown or purple (entirely dark purple to black lower pitchers and olive grey to blackish green upper pitchers).

Terrestrial, sometimes epiphytic, erect, sub-scandent or climbing shrub, to at least c. 3 m tall. Stems terete to markedly angular, branched, 2–4 mm in diameter. Internodal length up to 7 mm in rosettes, 1.5–3 cm in short stems, 3–10 cm in climbing stems.

Phyllodes sessile, ±spirally arranged. Laminae coriaceous, linear-obovate to obovate with acute to acuminate apex in rosettes, linear to linear-obovate with acute to acuminate apex in short and climbing stems, 7.5 cm long by 1.5 cm wide in rosette phyllodes, 6.3–14.5 cm long by 1.3–2.3 cm wide in phyllodes of short and climbing stem, margins entire, base clasping stem for 3/4 of its circumference, not decurrent, vernation primarily involute with minor marginal overlap. Longitudinal veins ≤4 on either side of midrib in the marginal 2/3 of lamina, not discernible in living specimens, barely conspicuous in herbarium material, pinnate veins numerous, at 40–80° from the midrib, overlapping the longitudinal veins. **Tendrils** of lower pitchers uncoiled, c. 21 cm long, 1.5 mm wide, tendril length to pitcher height ratio 1:1 to 2:1; of upper pitchers coiling once or twice, 7.5–16 cm long,

1–1.5 mm wide, generally of ratio 1:1 to 1.5:1. **Lower pitchers** slightly ventricose with hip usually located near midpoint, rarely below, cylindrical to broadly cylindrical above, 8.5–15 cm tall, 1.5–3.2 cm wide, tendril laterally attached, wings up to 2 mm wide with fringe elements c. 4 mm long running length of ventral face. Mouth ovate to triangular, oblique at front, becoming vertical towards rear, often recurved slightly over mouth, opposite sides of peristome not meeting, peristome cylindrical, often slightly flattened, 1–2 mm wide at front, varying little in width around the margin of the pitcher opening, ribs fine and hardly discernible, teeth indiscernible except on column where minute and rounded. **Lid** broadly ovate, orientated c. 20° from horizontal, 2.2–4.2 cm long, 1.7–3.9 cm wide, apex round, occasionally retuse, base cordate, lower surface lacking appendages, nectar glands round to elliptic, crateriform, rimmed with a low, thin margin, larger and denser near centre, where almost 0.5 mm in diameter, sparse and smaller elsewhere, to c. 0.1 mm near margins. Pitcher interior glandular in basal half and waxy above. **Spur** emergent near base of lid, usually divided into 3–4 branches, centremost processes 5–12 mm long, lateral branches 4–5 mm, rarely simple, apices acute. **Upper pitchers** cylindrical, often very narrowly so, 6.5–15 cm tall, 1.2–3.3 cm wide, tendril dorsally attached, wings reduced to ridges, prominent except below mouth where inconspicuous, ventral surface between wing remnants often flat, giving pitchers distinctly angular appearance. Mouth ovate to rounded-triangular, oblique at front, becoming vertical towards rear, often recurved slightly over mouth, peristome cylindrical, often slightly flattened, 1–2 mm wide at front with little variation even at column, ribs fine and hardly discernible, teeth rounded. Lid and spur similar to those of lower pitchers. **Inflorescence** a racemose panicle. Male inflorescence two-flowered in lower half and one-flowered above, occasionally one-flowered throughout, c. 60 flowers in total, peduncle c. 12–14 cm long, 2 mm wide, rachis c. 16–18 cm long, bracts prominent, (1–)2(–3) mm long, abaxially emergent on partial peduncles, situated close to ramification point of two-flowered partial peduncles, basal in one-flowered partial peduncles, simple, filiform, consistently produced. Tepals broadly elliptic, c. 2 mm long, 1 mm wide, apex obtuse to round. Female inflorescence poorly known, one- and two-flowered, partial peduncles bracteate, seeds not documented. **Indumentum** of light orangey brown, c. 0.3–0.5 mm long hairs present on stems, tendrils of lower pitchers, and abaxial midribs; smaller hairs present on phyllode margins; other parts of plant appearing glabrescent. **Colour** (in live plants) of mature stems yellow green, red brown, dark purple, or nearly black. Phyllodes bright green, midrib yellow green or dark red entirely or nearer the stem both adaxially and abaxially. Lower pitchers pale yellow green, very rarely orange, heavily speckled with brown to purple. Peristome entirely yellow green with outer margin suffused light orange to red, sometimes entirely red brown or entirely dark brown or dark purple, darkening markedly with age. Lower pitcher lid as per the pitcher body on the upper surface, yellowish green heavily speckled with dark brown to dark purple on upper surface, yellowish green on the lower surface with dark brown or purple margins; interior of the pitcher glaucous pale green or blue green with no markings. Upper pitchers with colouration as per the lower pitchers. (Figs. 1–4)

Etymology: The specific epithet *batik*, used here as a noun in apposition, refers to the distinctive dark-speckled pitcher colouration of this species, which may call to mind the intricate

'batik' patterns applied to textiles using the traditional Indo-Malay technique of the same name (see Kerlogue 2004). Indeed, contemporary Malaysian batik designs occasionally incorporate motifs inspired by *Nepenthes* pitchers (Hairuddin 2017; Ghazalli *et al.* 2023: 13).

Distribution and habitat: *Nepenthes batik* is known with certainty only from the upper reaches of two peaks in the Fraser's Hill area—Pine Tree Hill (Bukit Pokok Pain; 1448 m) and nearby Twin Peak (Puncak Kembar; 1505 m)—as well as from Gua Tinggi (1403 m), c. 11 km to the northwest (Fig. 5), this last locality based on herbarium material from 1930 (*Strugnell 20428*, KEP!). All three localities are within Pahang's Raub district. Geologically, these mountains are primarily granitic, as is the rest of the Main Range, with a variable contribution from metasediments (Roe 1951; Latiff *et al.* 2001a). The confirmed elevational range of this species is rather narrow, ranging from c. 1300 m to the summit of Twin Peak at 1505 m, though the holotype was perhaps collected at a lower elevation (minimally c. 1000 m; see "Notes on specimens examined").

Surprisingly, there appear to be no records of *Nepenthes batik* from Gunung Semangko (1824 m), which is located only c. 5.5 km NW of Twin Peak and along the same ridge line. It is possible that the species is highly localised, though it is more likely that the small known extent of occurrence reflects a lack of botanical exploration beyond the immediate vicinity of the hiking trail.

Nepenthes batik is easily observed at the summits of both Pine Tree Hill and Twin Peak; the documented population consists of approximately 50–100 plants in total and could comprise considerably more if, as is likely, it extends well beyond the trail. The species grows in dense ericaceous scrub and stunted ridge forest and appears to be primarily terrestrial (Fig. 2A–B), often occurring in association with *Sphagnum* moss (Fig. 2E–F), though on Pine Tree Hill it was also observed growing amongst dry leaf litter (Fig. 2G). Occasionally, it grows epiphytically on tree trunks, sometimes many metres off the forest floor (Fig. 2C–D).

In the summit area of Twin Peak, *Nepenthes batik* is sympatric with *N. berbulu* H.L.Tan, G.Lim, Mey, Golos, Wistuba, S.McPherson & A.S.Rob.; four adult plants of the latter species were found there during field observations in April 2023 (B. Hagger, pers. observ.). *Nepenthes batik* appears to be the only representative of its genus found on the comparatively drier peak of Pine Tree Hill. *Nepenthes sanguinea* is found at somewhat lower elevations along the summit trail, though it has apparently also been recorded from the summit area (*Nur 11057*, SING!). At still lower elevations in the general Fraser's Hill area, one finds a standard assemblage of lowland *Nepenthes* species, namely *N. ampullaria* Jack, *N. gracilis* Korth., *N. mirabilis* (Lour.) Druce, and *N. cf. domei* M.N.Faizal, A.Amin & Latiff (G. Lim, pers. observ.; cf. Adam 2009: 33; Go 2021: 116). Local reports of *N. albomarginata* T.Lobb ex Lindl. and *N. rafflesiana* Jack (Go 2021: 116) are likely unfounded. A plant from Fraser's Hill identified by Cheong (2023: 49–50, 2 figs.) as *N. gracilis* × *N. sanguinea* appears to represent *N. sanguinea* in its pure form; such a cross has never been recorded in the wild to our knowledge. For an overview of the broader flora of Pine Tree Hill – Twin Peak and its surroundings, see Kiew (1998).

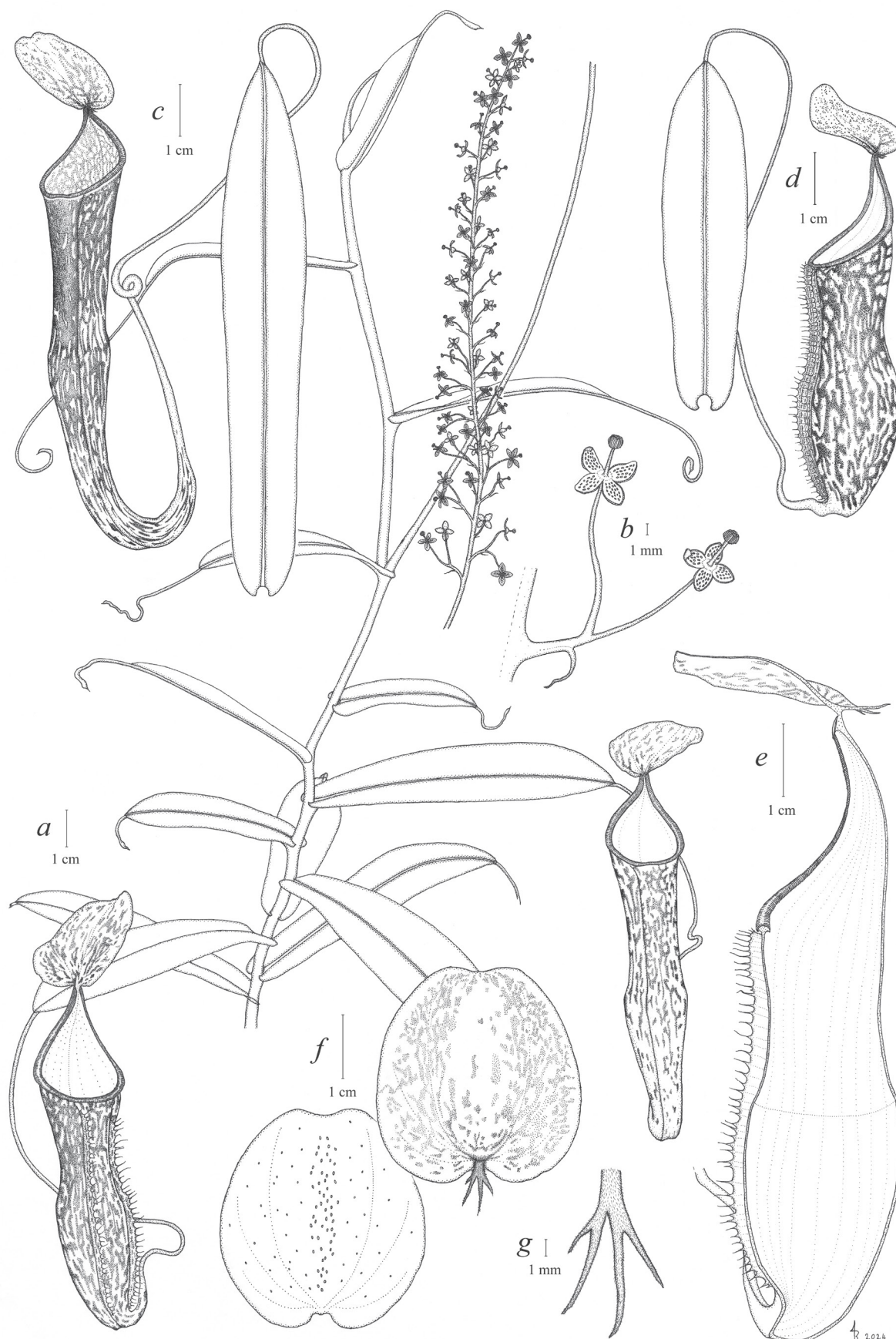


Figure 1. *Nepenthes batik* G.Lim, Golos, Mey, Wistuba & A.S.Rob. (A) Habit, showing rosetted growth transitioning to climbing stem, with lower and intermediate pitchers as well as male inflorescence. (B) Two-flowered partial peduncle bearing male flowers and abaxial bract. (C) Upper pitcher and adaxial view of associated phyllode. (D) Lower pitcher and phyllode at same scale. (E) Section of lower pitcher showing general form and venation. (F) Opposing surfaces of lid, lower surface (left) showing distribution and size variation of glands, and upper surface (right) with emergent spur. (G) Spur, with few branches. Drawn from observations made *in situ* and from herbarium specimens (Allen s.n., Banfield s.n., Pursglove P.4195, all SING; Strugnell 20428, KEP). Illustration by A. Robinson.



Figure 2. Habit and habitat of *Nepenthes batik* on Twin peak (A–B, E–F) and Pine Tree Hill (C–D, G). (A) Short-stemmed plant growing on a mossy tree base in ridgetop forest. (B) Dwarfed vining plants growing among exposed summit scrub. (C) Fallen tree supporting short-stemmed epiphytic plant (at base and immediately to the left of central branch). (D) Epiphytic plant bearing lower pitchers. (E) Rosettes bearing lower pitchers, some partly buried in *Sphagnum* moss and leaf litter, (F) Plant with lower pitchers growing horizontally along *Sphagnum*. (G) Short climbing plant with upper pitchers growing in exposed and conspicuously dry situation surrounded by leaf litter. Photographs by M. Golos (A–B, F–G) and B. Hagger (C–E).



Figure 3. Rosette, lower, and intermediate pitchers of *Nepenthes batik* from Twin Peak (A–D, F, H–I) and Pine Tree Hill (E, G). (A) Group of young rosetted plants growing among *Hymenophyllum* sp. ferns. (B) Small rosette pitcher among *Sphagnum* moss; note bifurcated spur. (C) Trio of lower pitchers; note younger central trap with peristome yet to attain its mature colouration. (D) Lower pitcher recumbent over a large mass of *Sphagnum*. (E) Particularly dark lower pitcher with conspicuous flaring towards mouth; note resemblance to *N. ramispina*. (F) Intermediate pitcher exhibiting dorsolateral tendril attachment and retention of fringed wings. (G) Aerial intermediate pitcher with twining tendril still bearing full-length fringed wings (H) Abaxial lid surface of pitcher; note concentration of minute nectar glands along reddish midline. (I) Detail of branched spur on pitcher. Photographs by G. Lim (A–B, H), M. Golos (C–D, F), B. Hagger (E, G), and F. Mey (I).



Figure 4. Upper pitcher of *Nepenthes batik* from Twin Peak (A–C, E–F, H–I) and Pine Tree Hill (D, G). (A) Elongated upper pitcher with purple-brown speckling. (B) Smaller, near-black upper pitcher growing in a more open area. (C) Particularly diminutive upper pitcher from an exposed site. (D) Pair of unusually tall upper pitchers. (E) Typical upper pitcher; note spent male inflorescence at right. (F) Typical slender upper pitcher; note twining of tendril for support. (G) Large upper pitcher with pronounced flaring towards mouth; note resemblance to *N. ramispina*. (H) Small upper pitcher with hand for size comparison; note narrowly acute laminar apex. (I) Small ants feeding at the peristome nectaries of an upper pitcher. Photographs by M. Golos (A–B, F), A. Wistuba (C), F. Mey (D–E), B. Hagger (G), and G. Lim (H–I).

The prey assemblage and infaunal community of *Nepenthes batik* have not been studied. Small, black ants were observed on the pitchers and drinking nectar from the peristome (Fig. 4I).

Conservation status: *Nepenthes batik* is known with certainty only from the summit regions of Pine Tree Hill and adjacent Twin Peak, as well as Gua Tinggi 11 km to the northwest (Fig. 5). While it might seem reasonable to assess the taxon as CR (Critically Endangered) against the IUCN (2012) Red List criteria based on the known area and extent of occurrence (AOO and EOO), it should be noted that the three peaks are situated on or close to Pahang's border with Perak, and are part of a more or less contiguous ridgeline of rather poorly botanised peaks of c. 1200–1900 m elevation, separated from other peaks in the north and south by terrain below 960 m elevation. Since the taxon appears to occur exclusively at or above c. 1300 m, and in the absence of significant explorations along much of this ridgeline with the exception of Gunung Semangko (1824 m) and nearby

Gunung Liang (1933 m) (from neither of which *N. batik* has been collected), this somewhat elevationally isolated set of peaks is inferred to be the maximum potential area of occurrence as no collections have been made from any other peaks north or south. The area of terrain above 1300 m within this contiguous zone amounts to 87 km² and, accordingly, the taxon is assessed as EN (Endangered), satisfying criteria B2ab(iii,v); that is, having an EOO of less than 500 km² and not being known from more than five locations, with observed and inferred declines in area, extent and quality of known habitat at its Pine Tree Hill and Twin Peak locations owing to tourism pressure, and the threat of poaching by collectors. While the taxon may satisfy criterion C2a(i) (no subpopulations exceeding 250 mature individuals), there is no observational data across the remainder of its inferred EOO with which to be able to make a scientifically sound judgement. Further explorations in the region would serve to refine this assessment.

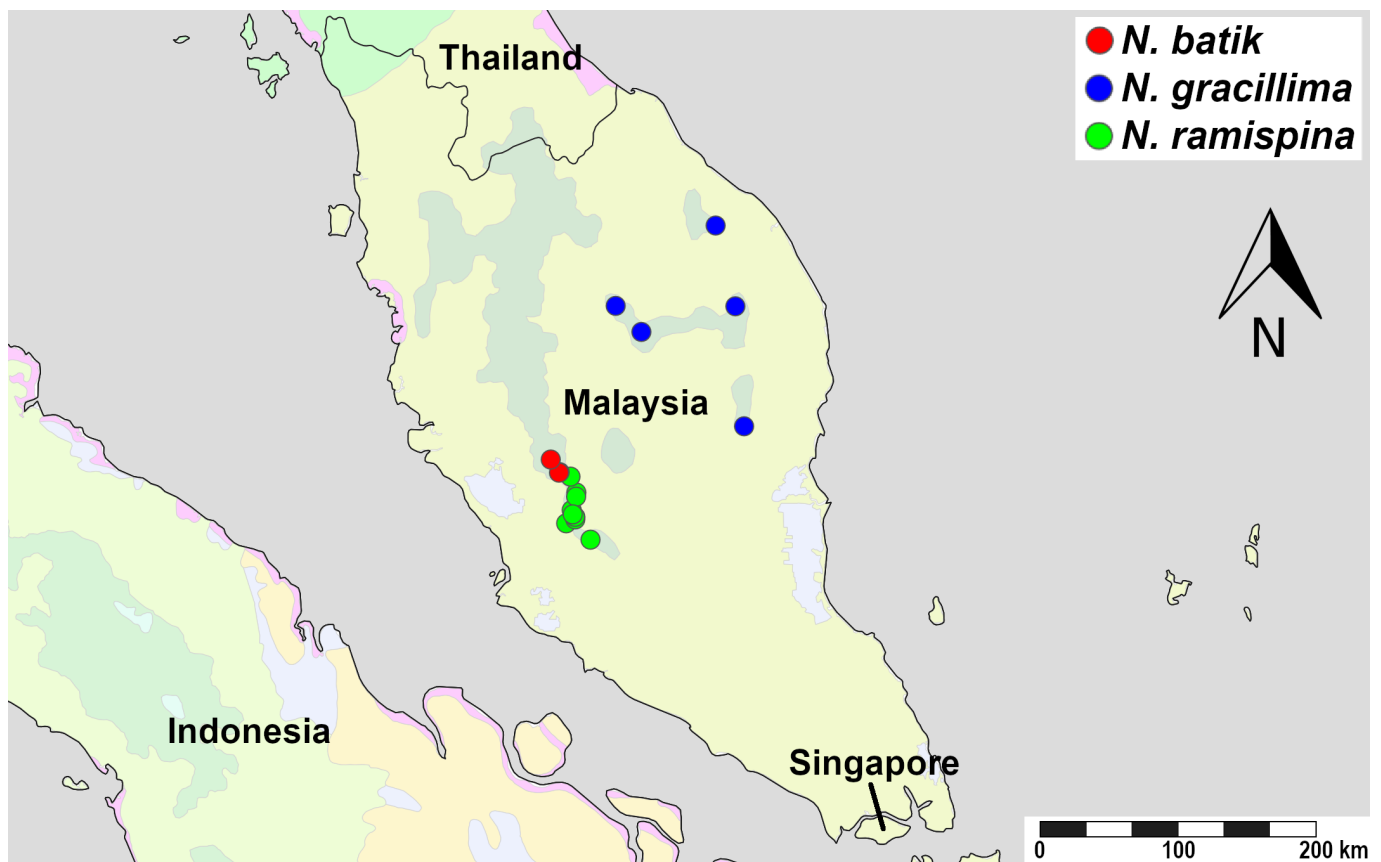


Figure 5. Known distributions of *Nepenthes batik*, *N. gracillima*, and *N. ramispina*, based on field observations and voucher specimens. The coloured areas distinguish between ecoregions defined by the World Wildlife Fund (see Olson *et al.* 2001); note that all three species are confined to the 'Peninsular Malaysian montane rain forests' ecoregion, which roughly corresponds to areas above 1000 m in elevation (see Loucks N.d.). Map prepared by M. Golos.

All currently known locations of *Nepenthes batik* are under Pahang State Government jurisdiction, thus any illegal removal of protected plants (such as *Nepenthes*) or animals is an offence under the National Forestry Act 1984 (revised 1993; FAOLEX N.d.). All locations are frequently patrolled by forest rangers, and visits require permits along with licenced guides from the Forestry Department of Pahang.

Despite this, local authorities report *Nepenthes* poaching activities over a long period (CITES 1987: [3]; Kiew 1992b: 37; Cheong 2013: 24, 2023: 49–50), even of common species like *N.*

sanguinea, to the extent that populations have severely declined along popular tourist trails (WWF-Malaysia N.d.: 13). This is reflected in the observations of Clarke (2002: 31), who wrote: "Although *N. macfarlanei* [Hemsl. = *N. berbulu*] and *N. ramispina* [= *N. batik*] have also been recorded from Bukit Fraser, no remaining populations of these species are readily accessible." According to Pahang State Government statistics, as many as 5000 tourists visited Fraser's Hill on a monthly basis in 2022 (FHDC 2022); such large numbers of tourists potentially visiting sensitive *Nepenthes* habitats puts the plants at risk from direct anthropogenic pressures beyond poaching. These pressures

include habitat degradation as a result of high foot traffic exacerbating soil erosion and trampling of sensitive *Sphagnum* moss banks, any associated changes in humidity and hydrology, as well as picking of pitchers and stems for curiosity value, and widespread persistent littering.

Local NGOs have recommended that Fraser's Hill be gazetted as a state park. The enactment of such a measure may help local authorities to enforce anti-poaching laws and develop effective long-term conservation strategies (Jacobs 2023).

Natural hybrids: *Nepenthes batik* is known to naturally hybridise with *N. berbulu*, with which it is sympatric. During our field observations in 2022, we found only a single unambiguous representative of this cross on Twin Peak (Fig. 6A–F) among many plants of *N. batik* and a trio of *N. berbulu*. Unlike the plants of *N. batik*, which grew in somewhat sheltered conditions among summit vegetation, often in association with *Sphagnum* moss, the single hybrid was found in an exposed situation, surrounded by bare, rocky substrate (Fig. 6A, D). The hybrid differs from *N. batik* most obviously in the considerably larger size of its pitchers, which bear broad peristomes (Fig. 6C–D). The lid is orbicular with much larger, crateriform nectar glands on its lower surface; these glands are scattered more or less evenly across the entire surface with the exception of the peripheries (Fig. 6E–F). The specimen seen by us lacked lid bristles entirely. The hybrid also bears laminae that are much larger and more robust than those of *N. batik*, being closer in general form to those of *N. berbulu* (Fig. 6B).

A single putative hybrid between *Nepenthes berbulu* and *N. sanguinea* has been recorded from Pine Tree Hill (Fig. 6G; B. Hagger, pers. observ.).

Additional specimens examined: *Nepenthes batik* — Pine Tree Hill, c. 4800 ft [≈1460 m], 21 March 1929, *Holttum* 21546 (SING! [#0094081]) [whole plant with intermediate pitchers and roots; identified as simply “*Nepenthes*” initially, as “[i]ntermediate form (hybrid?) [...] as far as may be concluded from these non-flowering parts” between *N. gracillima* and *N. sanguinea* by B.H. Danser (1929), as *N. gracillima* by M. Jebb (January 1995), as *N. gracillima* × *N. sanguinea* by Jebb & Cheek 1997: 99, and as *N. ramispina* × *N. sanguinea* by R. Kiew (17 April 2007)]; Gua Tinggi, Ulu Liang, steep habitat, no elevation data, 11 March 1930, *Strugnell* 20428 (KEP! [#12983]) [two stem fragments with upper pitchers; identified as *N. gracillima* initially and later by M. Jebb (January 1995) and as *N. ramispina* by Jebb & Cheek 1997: 102 and C.L. Lim (4 January 2007)]; Pine Tree Hill, c. 4600 ft [≈1400 m], June 1933, *Banfield* s.n. (SING! [2 sheets: #0094090 & 0094091]) [stems with lower pitchers and roots (both sheets); identified as *N. gracillima* initially and as *N. ramispina* by Jebb & Cheek 1997: 78]; Pine Tree Hill, path, forest, 4200 ft [≈1280 m], 19 April 1955, *Purseglove* P.4195 (A! [#01871273], L! [#1857158/0885534], SING! [#0094070]) [aerial offshoot with intermediate pitchers (A), stem with upper pitchers (L), stem with upper pitcher and male inflorescence (SING); label reads: “Climber. Pitchers green with purplish-brown blotches. Flowers brownish-green.”; identified as *N. gracillima* initially by J.W. Purseglove (all sheets), as *N. ramispina* by Jebb & Cheek 1997: 78 (SING), and as *N. ramispina* (with possible *N. macfarlanei* introgression) by V. Rybka (L, 17 August 2007)]; Pine Tree Hill, near summit, hill

forest, 4700 ft [≈1430 m], 18 August 1960, *Burkill, Shah & Noor* HMB 2383 (A! [#01945530], L! [#1857163/0885530], SING! [#0094087]) [stem with intermediate pitchers (A), stem with upper pitcher(s) (L, SING); label reads: “Pitchers grey and green”; identified as *N. gracillima* initially by H.M. Burkill (all sheets), as *N. ramispina* × *N. sanguinea* by V. Rybka (L, 17 August 2007), and as *N. ramispina* by S. Lee (SING, 8 July 2004); NB: mixed collection number—L sheet #1857155 appears to be *N. batik* × *N. berbulu* (see there)].

? *Nepenthes batik* × *Nepenthes berbulu* — Pine Tree Hill, hill top, in moss, 4400 ft [≈1340 m], 15 April 1926, *Strugnell* FMS 11130 (KEP! [#12976]) [stem with upper pitchers; identified as *N. sanguinea* initially by E.J. Strugnell, as *N. gracillima* by M. Jebb (January 1995), as *N. ramispina* by Jebb & Cheek 1997: 78 and C. Clarke (18 March 2011), and as *N. ramispina* × *N. sanguinea* by C.L. Lim (5 January 2007)]; Pine Tree Hill, hill top, 4400 ft [≈1340 m], 15 April 1926, *Strugnell* FMS 11131 (KEP! [#12944]) [stem with lower pitcher; identified as *N. sanguinea* initially by E.J. Strugnell, as *N. macfarlanei* by M. Jebb (January 1995), as “probably” *N. sanguinea* by M. Cheek (January 1996), as *N. macfarlanei* by Jebb & Cheek 1997: 102, and as *N. ramispina* by C. Clarke (18 March 2011)]; Pine Tree Hill, hill top, 4400 ft [≈1340 m], 10 July 1927, *Strugnell* FMS 12871 (KEP! [#12977]) [stem with upper pitcher and male inflorescence; identified as *N. ramispina* initially by E.J. Strugnell, as *N. gracillima* by M. Jebb (January 1995), and as *N. ramispina* by Jebb & Cheek 1997: 78 and C.L. Lim (4 January 2007)]; Pine Tree Hill, 4800 ft [≈1460 m], 30 December 1939, *Holttum* 36510 (SING! [2 sheets: #0094146 & 0094147]) [stem with large upper pitcher, two rosettes with pitchers (#0094146), stem with upper pitchers and male inflorescence, seedling (#0094147); label reads: “This is the common species on Pine Tree Hill. Pitchers slender, pale green with dark purple markings. Glands on lid very numerous. Teeth in peristome very short. Lid slightly raised above horizontal.”; identified as *N. gracillima* initially and as *N. sanguinea* by M. Jebb (both sheets, January 1995) and Jebb & Cheek 1997: 99; NB: may represent mixed collection, with rosettes belonging to *N. sanguinea*]; Pine Tree Hill, summit, 4500 ft [≈1370 m], 23 September 1940, *Addison* 37377 (SING! [#0094071]) [stem with upper pitchers and infructescence; label reads: “Pitchers striped, dull, greenish purple, soil peat”; identified as “*Nepenthes* sp.” initially, as *N. gracillima* by R.E. Holttum (undated), and as *N. ramispina* by Jebb & Cheek 1997: 78]; Pine Tree Hill, summit, among rocks, 4780 ft [≈1457 m], 19 April 1955, *Purseglove* P.4225 (L! [#1857162/0885531], SING! [#0094142]) [stem with upper pitchers and male inflorescence (both sheets); label reads: “Climber. Pitchers green mottled purple. Inflorescence axis and peduncles golden brown. Perianth green. Anthers yellow.”; identified as *N. gracillima* × *N. sanguinea* initially by J.W. Purseglove (both sheets), as *N. sanguinea* by M. Jebb (SING, January 1995), as a mix of *N. sanguinea* and possibly *N. ramispina* by Jebb & Cheek 1997: 101, and as *N. ramispina* × *N. sanguinea* by V. Rybka (L, 17 August 2007)]; Pine Tree Hill, near summit, hill forest, 4700 ft [≈1430 m], 18 August 1960, *Burkill, Shah & Noor* HMB 2383 (L! [#1857155]) [stem with upper pitcher and male inflorescence; label reads: “Pitchers grey and green”; identified as *N. gracillima* initially by H.M. Burkill and as *N. ramispina* by C. Clarke (21 August 2012); NB: mixed collection number—A, L sheet #1857163 and SING represent *N. batik* (see there)].



Figure 6. Putative natural hybrids involving *Nepenthes batik*: a single plant from Twin Peak appearing to represent *N. batik* × *N. berbulu* (A–F) and a possible cross with *N. sanguinea* from Pine Tree Hill (G). (A) Exposed habitat of putative *N. batik* × *N. berbulu* plant (visible at bottom-centre); *N. batik* grew among the shrubs in the immediate vicinity of this clearing. (B) Detail of stem and leaf bases. (C) Upper pitcher (April 2023); note large size compared to equivalent traps of *N. batik*. (D) Overview of entire plant taken when it still bore lower and intermediate pitchers (August 2022). (E) Adaxial lid of lower-intermediate pitcher; note unbranched spur. (F) Abaxial lid of lower-intermediate pitcher; note comparatively large size of nectar glands and their even distribution across the whole surface. (G) Possible hybrid between *N. batik* and *N. sanguinea*; note long, distally bifurcated spur. Photographs by G. Lim (A–B, E), B. Hagger (C, G), F. Mey (D), and M. Golos (F).

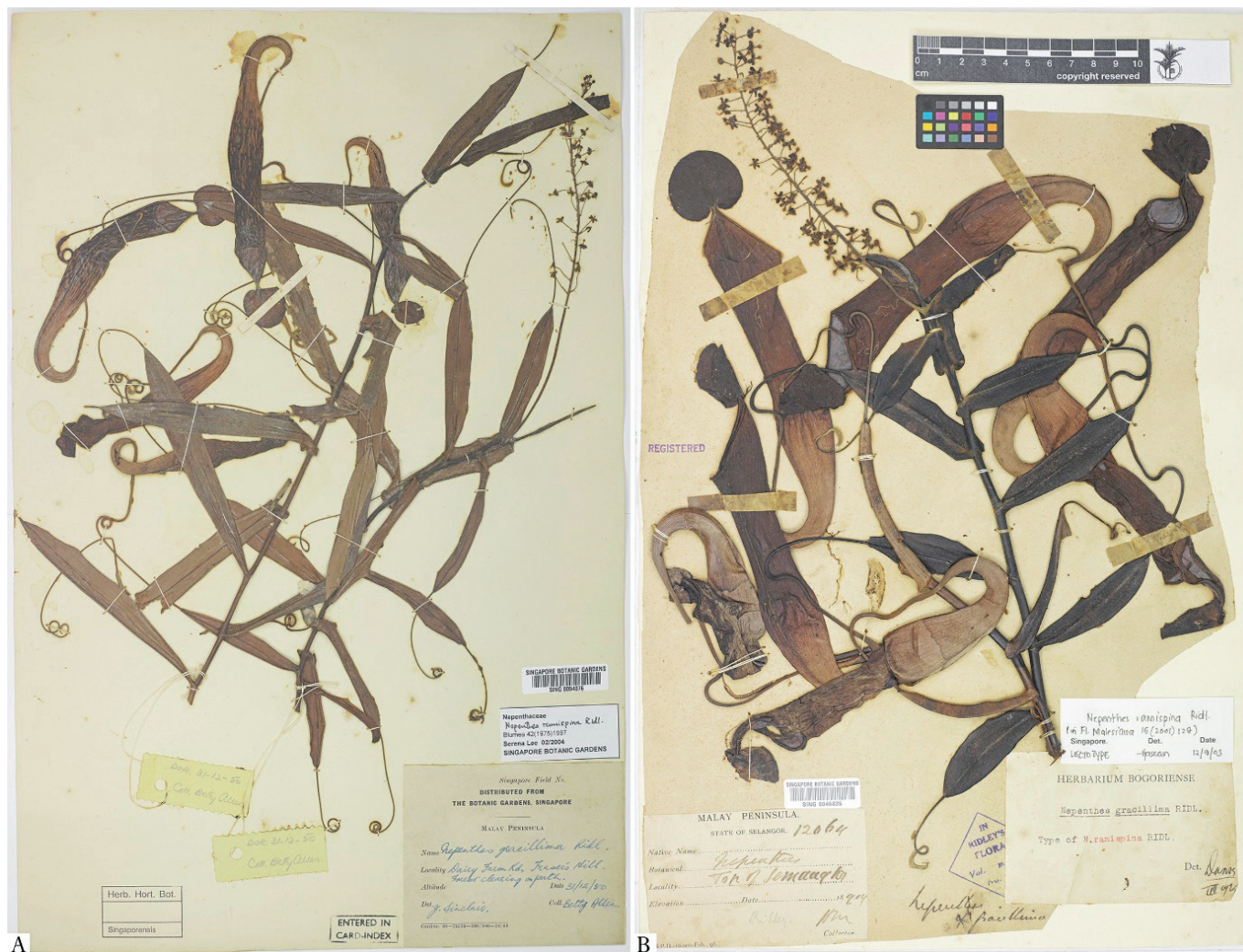


Figure 7. Holotype of *Nepenthes batik* (Allen s.n.; A) and lectotype of *N. ramispina* (Ridley 12064; B), shown to scale (refer to ruler in B). Both specimens are deposited at the Singapore Botanic Gardens Herbarium (SING). Note the comparatively narrow laminae, long tendrils, and diminutive, gracile and mottled pitchers of *N. batik*. Permission to reproduce images courtesy of SING Herbarium, National Parks Board.

For a list of examined exsiccata of *Nepenthes gracillima*, *N. ramispina*, and *N. sanguinea*, see the Appendix.

Notes on specimens examined: Collection bias towards large-pitched plants might explain the prevalence of putative hybrid material among the examined voucher specimens from Pine Tree Hill, or else historical abundance of these plants along the summit trail, where the more exposed habitat might favour their growth.

The type locality of *Nepenthes batik*, as recorded on Allen s.n. (SING; Fig. 7A), is “Dairy Farm Rd.”. This must refer to the road leading to the experimental dairy farm that served Fraser’s Hill during its early history (see Aiken 1994: 44 and Ibrahim-Bell 2019: 20, 41) and was located in Jeriau, a valley lying several kilometres northwest of the main hill station and at the foothills of the Pine Tree Hill – Twin Peak ridgeline. The elevation of the dairy farm was variously reported as c. 3200–3300 ft (≈975–1005 m)

(SSFMS 1937: 8; Madoc & Allen 1952: 164). By comparison, the main Fraser’s Hill complex (from which the road led) is situated at c. 1300 m, as is Bukit Jeriau, the highest point directly adjacent to the road (see Kiew 1998: 24, fig. 2). Since the type specimen was collected at some unspecified point along the road (“forest clearing on path”), it can be inferred that it was growing at an elevation of between c. 1000 and 1300 m.

While it would be our strong preference to designate as the holotype a specimen deposited in the species’ country of origin, no material that can be unambiguously assigned to *Nepenthes batik* was found by us at KEP, with the exception of a single specimen (*Strugnell* 20428) that is rather incomplete and lacking floral material. Further material from Pine Tree Hill held at KLU, which is likely to include *N. batik* and/or *N. batik* × *N. berbulu* but has not been seen by us, is enumerated by Jebb & Cheek (1997: 77–78), where it is identified as belonging to *N. ramispina*.

Table 1: A comparison of *Nepenthes batik*, *N. ramispina*, and *N. gracillima*. Morphological characters of the three taxa are based on herbarium material supplemented with field observations made in the Titiwangsa Range (Pine Tree Hill and Twin Peak in Fraser's Hill, and Gunung Ulu Kali in the Genting Highlands) and the Timur Range (Gunung Tahan and a second locality in Terengganu).

	<i>N. batik</i>	<i>N. ramispina</i>	<i>N. gracillima</i>
Geographical range	Southern Titiwangsa Range (north of The Gap)	Southern Titiwangsa Range (south of The Gap)	Timur Range, Tapis Range, Terengganu Hills
Elevational range (m)	(?1000–)1300–1505	900–2000	900–2000
Phyllodes	Linear-obovate, apex narrowly acute to acuminate	Obovate-oblong, apex round to broadly acute	Linear to lanceolate, apex acute
Tendrill length	Longer than pitchers	Shorter than pitchers	Longer than pitchers
Spur	Simple to divided into 3–4 branches	Divided into (3–)4–10 branches	Simple, sometimes with two short, thick bristles at the apex in pitchers of seedling rosettes
Hairs on lower surface of lid	Absent	Absent	Conspicuous, to 2 mm long
Lower pitchers	Basally ventricose, with hip typically located near midpoint, rarely below, broadly cylindrical to cylindrical above. Peristome ribs fine, hardly discernible, teeth indiscernible except on column where minute and rounded	Narrowly cylindrical throughout, sometimes slightly basally ventricose with hip located towards lower third of pitcher body. Peristome ribs fine, hardly discernible, teeth largely indiscernible	Ovoid in lower half, narrowing slightly above and cylindrical towards pitcher opening, to sub-ovoid throughout. Peristome ribs distinct, teeth pronounced, narrow, up to 2 mm long
Size of lower pitchers (cm)	8.5(–15)	(10–)15(–22)	≤22
Colour of lower pitchers	Exterior yellowish green heavily speckled with brown to purple, interior light yellowish green without markings. Peristome light green to yellow in newly opened pitchers then suffused with orange, brown or purple, sometimes entirely dark purple as the pitchers ages	Exterior dark purple to black, interior pale green without markings. Peristome bright yellow in newly opened pitchers then purple or black as the pitchers age	Yellowish green, speckled dark red or purple, interior pale yellowish green. Peristome green or reddish in newly opened pitchers, then often striped with bands of dark red or purple to sometimes entirely dark purple as the pitchers age
Lid of lower pitchers	Ovate, base markedly cordate, glands clustered and larger along midline, minute and sparse towards margins	Orbicular, often slightly broader than long, base cordate, glands of ±uniform distribution and size	Elliptic to ovate, glands conspicuous, larger along midline and sparse towards margins
Upper pitchers	Mouth height 1/5 to 1/6 of total pitcher length. Pitchers angular, cylindrical to very narrowly cylindrical, with distinct hip 1/3–1/2 from base, and slightly flaring towards pitcher opening	Mouth height 1/4 to 1/5 of total pitcher length. Pitchers angular, cylindrical, with distinct hip 1/3–1/2 from base, and slightly to significantly flaring towards pitcher opening	Narrowly infundibular in the lower 1/3, gradually contracted above the hip, cylindrical above
Size of upper pitchers (cm)	(6.5–)10(–15)	14–20(–24)	≤26 for early upper pitchers; ≤10 for late-stage upper pitchers
Colour of upper pitchers	Exterior yellowish green heavily speckled with brown to purple, interior pale green or blue green without markings. Peristome light green to yellow in newly opened pitchers then suffused with orange or brown as the pitchers age	Exterior olive to blackish green, interior light pale green or blue green without markings. Peristome light green to yellow in newly opened pitchers then suffused with red or purple as the pitchers age	Bright green, but often so strongly speckled with black as to appear almost uniformly black with green speckling. Peristome yellow, striped with narrow bands of black and purple or entirely dark purple, almost black
Lid of upper pitchers	As in lower pitchers	As in lower pitchers	As in lower pitchers

Key to the highland *Nepenthes* species of the southern Titiwangsa Range, Malaysia

1. Pitchers with lid hairs 2
- 1: Pitchers without lid hairs 3
2. Lid hairs ≥5 mm long, upper pitchers broadly cylindrical, white with dark speckling, base green *N. berbulu*
- 2: Lid hairs ≤3 mm long, upper pitchers infundibular with hip absent or located just below peristome, base green, yellow to creamy white above *N. ulukaliana*
3. Stem round, spur typically with 3–10 branches 4

- 3: Stem sharply angular, spur simple or with 2–3 branches *N. sanguinea*
4. Laminae obovate-oblong with acute to round apices, tendrils generally shorter than pitchers, spur divided into (3–)4–10 branches, lid glands orbicular, of uniform size and distribution, lower pitchers dark purple to black, upper pitchers olive to blackish green *N. ramispina*
- 4: Laminae linear-obovate with acute to acuminate apices, tendrils generally longer than pitchers, spur divided into 3–4 branches, lid glands ovate, clustered and largest along midline, all pitchers brown to purple-speckled *N. batik*

Botanical history

Though hitherto unrecognised as a distinct species, *Nepenthes batik* has been collected on a number of occasions since the first half of the 20th century. Owing to its somewhat intermediate appearance, material belonging to this species has been variously identified as *N. gracillima*, *N. ramispina*, *N. gracillima* × *N. ramispina*, *N. gracillima* × *N. sanguinea*, and *N. ramispina* × *N. sanguinea*.

To our knowledge, the earliest herbarium material that can be unambiguously attributed to *Nepenthes batik* is a single specimen (Holttum 21546, SING!) collected on 21 March 1929 from Pine Tree Hill by Richard Eric Holttum (1895–1990), then director of the Singapore Botanic Gardens, during a ten-day stay in the Fraser's Hill area (see Steenis-Kruseman 2017). Earlier collections of similar *Nepenthes* from this locality, stretching back to 1926, appear to represent hybrid material involving *N. berbulu* (see "Additional specimens examined"). Notably, these collections were made only a few years after Fraser's Hill was opened to visitors in 1922 (for the early history of the hill station, see Scrivenor 1931; Maxwell 1954; Hale 2018; and Zaini *et al.* 2024), though the first botanical inventory of Burkill & Holttum (1923), comprising 373 species, recorded only *N. sanguinea*, which was described as "by no means uncommon from below [Fraser's Hill proper] at 3500 ft. [≈1070 m] almost to the summit of Pine-tree hill at 4800 ft. [≈1460 m]", and no further *Nepenthes* were added among the 173 new species records enumerated by Henderson (1927a) (species numbers after Kiew 1998: 3). Between 1930 and 1960, *N. batik* was collected on at least five more occasions by, in chronological order, Edmund Jardine Strugnell (1903–1975), Frederick Sydney Banfield (1899–1967; see Banfield 1933), Betty Molesworth Allen (1913–2002; whose specimen is herein designated as the type), John William Purseglove (1912–1991), and the trio of Humphrey Morrison Burkill (1914–2006), Mohamad Shah bin Haji Mohamad Noor (1935–2003) and Mohammed Noor bin Jumaat (1940–2015).

Benedictus Hubertus Danser (1891–1943), the pre-eminent *Nepenthes* monographer of the early 20th century, examined Holttum 21546 but considered it to be an intermediate form or hybrid between *N. gracillima* and *N. sanguinea* (see "Additional specimens examined"). However, since this specimen's collection postdated the publication of his seminal 1928 revision, *N. batik* was not treated therein, though Danser included within his broad concept of *N. gracillima* (see Lim *et al.* 2023) a single exsiccatum from Pine Tree Hill (Nur 11057, SING!) that likely represents *N. sanguinea* (see Danser 1928: 299).

For much of the 20th century, *Nepenthes batik* was—on the rare occasions that it was mentioned—conflated with *N. gracillima*, a taxon from Peninsular Malaysia's Timur Range (Eastern Range) into which was often also placed *N. ramispina* from the southern Titiwangsa Range (Danser 1928; Turner 1995; see Lim *et al.* 2023 for a detailed botanical history). Probably the earliest example of this conflation—and the first mention of *N. batik* in print—appeared in Holttum's (1940) article on Peninsular Malaysian *Nepenthes* for *The Malayan Nature Journal*. This work included what is likely the earliest published photograph of *N. batik* (identified as *N. gracillima*), taken by Danish planter Frederic C. Fogh (d. 1945) and depicting a pair of its characteristically speckled upper pitchers. Though no locality information is

provided, it was most probably taken on Pine Tree Hill, as this is one of the two localities given by Holttum (1940: 42) for his concept of *N. gracillima*, the other being the species' type locality on the distant Gunung Tahan in the Timur Range (from which he recorded also under this name diminutive white-pitched plants that no doubt represented *N. alba* (Ridl.) Ridl.). Holttum (1940: 42) wrote that the species was "common" along the summit trail to Pine Tree Hill and stated that there was "little doubt" it formed natural hybrids with both *N. macfarlanei* s.lat. and *N. sanguinea*, the former likely alluding to plants of *N. batik* × *N. berbulu* seen and collected by him earlier on Pine Tree Hill (e.g., Holttum 36510, SING!). In Holttum's view, these crosses made identification difficult, and he opined that "*N. gracillima* seems to be the least well-defined species of the [three], and needs further study" (Holttum 1940: 42).

Subsequent authors generally followed Holttum in recognising the summit *Nepenthes* flora of Pine Tree Hill (and Fraser's Hill more broadly) as consisting of *N. gracillima* (= *N. batik*) and *N. macfarlanei* (= *N. berbulu*) (e.g., Henderson 1959: 434; Shivas 1984: 17–18, 31; Kiew 1985, 1990, 1998; Chua 1995: 7, 187; Adam 2009: 33; Go 2021: 15, 116).

In their "skeletal revision" of the genus *Nepenthes*, Jebb & Cheek (1997) provided much-needed taxonomic clarity by splitting off *N. ramispina* from *N. gracillima* and lectotypifying the former with material from Gunung Ulu Semangko (Ridley 12064, SING!), though they lumped within their concept of *N. ramispina* herbarium specimens of *N. batik*, *N. gracillima*, *N. sanguinea*, *N. batik* × *N. berbulu*, and probably also *N. limiana* Wistuba, Mey, Golos, S.McPherson & A.S.Rob. (e.g., Allen s.n., Shah MS 2523, Nur 11057, Addison 37377, and Nur 12219, respectively, all SING!; see "Distribution of *Nepenthes ramispina*"). They largely maintained this species concept in their two subsequent works dealing with Peninsular Malaysian *Nepenthes* (Cheek & Jebb 2001, 2012); Ulu Liang (i.e., the headwaters of the Liang River) is explicitly mentioned as a locality of *N. ramispina* by Cheek & Jebb (2012: 270), likely based on material of *N. batik* from there (e.g., Strugnell 20428, KEP!). Following Danser's herbarium annotation, Jebb & Cheek (1997: 99) identified the oldest known specimen of *N. batik*—Holttum 21546—as the hybrid *N. gracillima* × *N. sanguinea*.

In her comprehensive monograph on the spermatophytes of Fraser's Hill, Kiew (1998: 68) wrote that plants of *Nepenthes gracillima* from this location (= *N. batik*) have "pitchers that are patterned with a green-flecked, reddish brown reticulum". She was of the view that the species "is found in its pure form on Pine Tree Hill, but around the township, the plants appear to be hybrids between this species and *N. macfarlanei*". Confusingly, *N. gracillima* was illustrated in this work with a photograph of an almost entirely green upper pitcher of *N. sanguinea* (see Kiew 1998: 115). In addition to Fraser's Hill, Kiew (1998: 68) considered *N. gracillima* to grow on Gunung Tahan, the Genting Highlands, and Bukit Kamunting (all in Pahang), G. Stong (Kelantan), G. Menuang Lebah (Selangor), and G. Padang and G. Tapis (Terengganu)—a broad species concept that certainly included *N. ramispina* and *N. sanguinea*, and likely also *N. alba* and *N. limiana* given the peaks in question. In Kiew's 2014 revised edition of M.R. Henderson's classic *Malayan Wild Flowers*, *N. batik* from Fraser's Hill is treated as *N. ramispina* (Henderson

& Kiew 2014: 45); in the original it had been identified as *N. gracillima* (Henderson 1959: 434).

A second photograph of *Nepenthes batik* (following that published in Holttum 1940) appeared in the 2004 German-language book *Karnivoren: Biologie und Kultur fleischfressender Pflanzen* (translated into English in 2007 as *The Curious World of Carnivorous Plants*), showing a single dark-speckled upper pitcher. The pitcher was identified as belonging to *N. ramispina* and contrasted against the entirely black lower pitchers of the latter species from Gunung Ulu Kali (Barthlott et al. 2004: 154); the same photograph of *N. batik* also features on the dust jacket spine of the English edition (Barthlott et al. 2007). It was subsequently determined that this photograph was taken by botanist Anton Weber on 14 June 1987 in the Fraser's Hill area on the way up from The Gap (A. Weber, pers. comm.).

Recently, *Nepenthes batik* was mentioned as an “undescribed taxon” in the type description of *N. berbulu*, where it was said to co-occur and hybridise with that species (Tan et al. 2023: 31). Similarly, it was referred to as an “undescribed species” in Lim et al. (2023: 2115).

Nepenthes batik came to the attention of author G. Lim in early 2015 when he came across a single photograph of a dark-speckled upper pitcher on the website fraserhill.info, which had at that point already hosted it for several years (Anonymous c. 2011). Lim suspected that the plant represented the then little-known *N. gracillima* based on its similarity to a photograph of the latter species appearing in McPherson (2009a: 585, fig. 317). However, if correct, this would place it outside the known range of *N. gracillima*, which at the time was thought to be restricted to Gunung Tahan (McPherson 2009a, 2009b; Clarke & Lee 2012; Clarke 2018). Seeking further input on the plant's identity, Lim shared the photograph from fraserhill.info (together with one other found online, showing an intermediate pitcher) on a Facebook discussion group dedicated to highland *Nepenthes* (Lim 2015). Identifications proposed by group members included *N. gracilis* (ruled out by the visible morphology and presumed highland occurrence of the taxon), a species allied to *N. macfarlanei* (difficult to assess owing to the concealed abaxial lid surface), or else *N. macfarlanei* × *N. ramispina*. The taxon was eventually visited in August 2022 by a team comprising G. Lim, M. Golos, F. Mey, and A. Wistuba, whereupon it became clear that it did not belong to any species of *Nepenthes* then recognised, accounting for the present work.

Discussion

The *Nepenthes* of Peninsular Malaysia have received significant attention in the last five years as a result of research carried out by Malaysian and international scientists (Ghazalli et al. 2020; Tamizi et al. 2020a, 2020b; Tan et al. 2023; Lim et al. 2023; Golos et al. 2023). The species of the region were historically neglected by revisionary efforts in *Nepenthes* owing to their perceived taxonomic complexity which was not resolvable in the absence of the systematic field research now well underway. During this period, many peaks were explored for the first time by *Nepenthes* specialists, revealing several taxa new to science. Two taxa related to *N. sanguinea* have been described, namely *N. latiffiana* M.N.Faizal, A.Amin & Dome and *N. malayanensis* A.Amin, M.N.Faizal & Dome, and another one, related to *N. benstonei*

C.Clarke, has been described as *N. domei* M.N.Faizal, A.Amin & Latiff. Perhaps more significantly, a combination of herbarium studies and *in situ* research led to the relocation of *N. macfarlanei* at its *locus classicus*, enabling a more accurate circumscription that eventually revealed a distinctive but closely related group of species bearing abaxial lid hairs all previously lumped under *N. macfarlanei*. The delimitation of this ‘*Nepenthes macfarlanei* group’, along with the other aforementioned newly described species, has given rise to a better understanding of Peninsular Malaysia's *Nepenthes* diversity along with a list of taxa that can be accurately keyed out.

The description of *Nepenthes batik* brings the total number of Peninsular Malaysian *Nepenthes* to 20. The morphological characters of *N. batik* place it very close to *N. ramispina* and account for why the taxon was easily presumed to represent the latter when first studied by the authors. For example, the two species produce very similarly shaped upper pitchers; however, both species can be reliably distinguished—even in the absence of pitchers—via a number of stable characters including size and overall stature, the shape of the phyllodes, the relative length of the tendrils, the degree to which the spur is branched, the shape of the lower pitchers, and the gland distribution and size on the lower surface of the lid (cf. Som 1988: 52, fig. 18C) (Table 1; Fig. 7). Though colouration is generally regarded as a secondary diagnostic in *Nepenthes*, all known populations of *N. batik* differ from *N. ramispina* in consistently producing yellowish green pitchers heavily speckled with brown to purple, rather than the uniformly dark-coloured pitchers of the latter taxon.

Although the two taxa can be reliably differentiated using the characters outlined here, it could be argued that describing *Nepenthes batik* at subspecies rank beneath *N. ramispina* would be appropriate given their putative close relationship. The authors opt against doing so given that there is no precedent for the subspecies concept in *Nepenthes*, while several published varieties have been elevated to species rank or, conversely, sunk (Danser 1928; Jebb & Cheek 1997; Cheek & Jebb 2001; Clarke et al. 2009).

The upper pitchers of *Nepenthes batik* also bear a close resemblance to the end-stage aerial traps (‘true’ upper pitchers sensu Clarke & Lee 2012) of *N. gracillima*, which is known only from the eastern mountain ranges of Peninsular Malaysia. However, unlike *N. gracillima*, *N. batik* does not fall within the recently circumscribed *N. macfarlanei* group (Lim et al. 2023) and, among other features, notably lacks hairs on the lower surface of the lid (Fig. 3H) and has a narrow peristome with almost indiscernible teeth and ribs (versus a distinct, finely toothed peristome that flattens and widens into a short column towards the rear) even in its most robust lower pitchers.

It is likely that *Nepenthes batik* has gone unrecognised as a species in its own right given its resemblance to *N. ramispina*, and perhaps as a result of the particular emphasis placed on the presence of a branched spur as a sufficient diagnostic trait for that taxon, just as the mere presence of hairs on the lower surface of the lid has, for decades, resulted in the inclusion of distinctive species like the recently described *N. sericea* Golos, Wistuba, G.Lim, Mey, S.McPherson & A.S.Rob. and *N. ulukaliana* A.S.Rob., Wistuba, Mey, Golos, G.Lim & S.McPherson under *N. macfarlanei* s.lat. (Lim et al. 2023). In addition, the highly

localised distribution of *N. batik* within Fraser's Hill has meant that it has repeatedly escaped the notice of botanists and naturalists, whose observations around the hill station have often been limited to *N. sanguinea* (e.g., Burkill & Holttum 1923; Hales 1928: 247; Latiff *et al.* 2001b: 265). This has historically applied also to amateur *Nepenthes* specialists, who—given the taxon's horticulturally desirable qualities—would otherwise likely have brought it to the attention of the wider hobbyist community (e.g., Hopkins *et al.* 1990: 26; Yeo 1996: 93, fig. 1).

Distribution of *Nepenthes ramispina*

Nepenthes ramispina has previously been recognised from across the Titiwangsa Range (see Cheek & Jebb 2012: 259, map 3), as far north as Gunung Batu Putih (2132 m; Cheek & Jebb 2012: 270) or Gunung Korbu (2183 m; Null 1972:203, 215), both in Perak, or even Gunung Stong (1422 m) in Kelantan (Jebb & Cheek 1997: 77). However, based on the totality of available evidence encompassing field observations, herbarium material, and citizen science photos, we determine that *N. ramispina* has a range that is restricted to the southern part of the Titiwangsa Range. As with *N. ulukaliana*, which appears to be nearly co-extensive, we have seen no evidence of *N. ramispina* occurring north of The Gap (c. 825 m; also known as the 'Semangko Gap' or 'Semangko Pass') in the Fraser's Hill region. During field observations in August 2022, only *N. sanguinea* was found by us on Gunung Gap (1183 m) and on neighbouring Gunung Ulu Semangko (1394 m)—both located just south of The Gap—though herbarium material from the early 20th century points to the presence of *N. ramispina* (and *N. ulukaliana*) on Gunung Ulu Semangko, which is the type locality of the former through lectotypification (see Lim *et al.* 2023; Fig. 7B).

Based on this circumscription, *Nepenthes ramispina* is known from at least ten peaks in the southern Titiwangsa Range, ranging from Gunung Ulu Semangko in the north to Gunung Nuang (1493 m) in the south, a span of some 50 km (Fig. 5). In the intervening regions, it has been recorded from several mountains along the Pahang–Selangor border, including Bukit Tunggul (1663 m), Gunung Bunga Buah (1430 m; see e.g., Rubeli 1986:196, fig.), Gunung Hulu Bakau (1347 m), Gunung Rajah (1685 m), and the Genting Highlands area, including Gunung Lari Tembaku (1709 m), Gunung Mengkuang (1424 m), Gunung Purun (c. 1700 m), and Gunung Ulu Kali (1772 m). As such, we consider *N. ramispina* to be restricted to the states of Pahang and Selangor, but absent from Kelantan, Negeri Sembilan, and Perak, from which it has previously been reported (e.g., Jebb & Cheek 1997: 77–78; Clarke 2001: 175, 305, map 7B; McPherson 2009a: 606, 2023: 1583; Thorogood 2010: 126; Cheek & Jebb 2012: 259, map 3, 270; McPherson & Robinson 2012: 43; Chua 2021: 526).

Plants resembling *Nepenthes ramispina*—bearing slender, uniformly dark pitchers with or without ramified spurs—have been recorded from the central parts of the Titiwangsa Range, including in the vicinity of the Lojing Highlands (e.g., at the foothills of Gunung Warpu, 1745 m; pers. observ.) but particularly around the Cameron Highlands, where the species (or, alternatively, *N. gracillima* s.lat.) has been attested to by numerous authors (e.g., Henderson 1927b: 263, 1959: 434; Kiew 1990: 37; Ghazalli *et al.* 2022: 36; see also iNaturalist 2018, 2024). This includes historical material from Telom attributed to both *N. gracillima* and

N. ramispina by Ridley (1909, 1924) and Jebb & Cheek (1997), and solely to the former by Macfarlane (1914) (see Ridley 13704 and Ridley s.n., both SING!, Jaamat 27665, KEP!; for a detailed botanical history, see Lim *et al.* 2023: 2094–2095), as well as reports of *N. gracillima* from Gunung Brinchang (2032 m) by Shivas (1984: 17) and Kiew (1985), and from Bukit Kamunting (Road) in the Cameron Highlands by Kiew (1998: 68) (cf. Burkill HMB 2847, LI, SING!). We have also seen comparable material from Gunung Besar Hantu (1462 m), the highest peak in Negeri Sembilan (Mohd Hairul FRI 70980, SAN!). Field studies and examination of all accessible specimens lead us to believe that these plants all fall within the natural variation of *N. sanguinea*. A record by Cheek & Jebb (2012:270) of *N. ramispina* from Gunung Benom (2107 m)—part of an isolated and eponymous massif lying east of the southern Titiwangsa Range—merits further investigation but is also likely to be *N. sanguinea*, this being the only *Nepenthes* species confirmed to occur there (see e.g., Ummul-Nazrah *et al.* 2011: 120).

Jebb & Cheek (1997: 77) and Clarke (2001: 133) identified a specimen from Gunung Stong in the northern state of Kelantan as belonging to *Nepenthes ramispina*. Only the recently described *N. limiana* is known with certainty to occur on this mountain. The latter taxon can occasionally produce pitchers with branched spurs which might have caused confusion with *N. ramispina*. The Stong material, Nur 12219 (SING), was originally identified as *N. gracillima* by Danser (1928: 299). Danser's concept of this species also included *N. ramispina* and he described the spur as being “strongly or slightly branched or not”. Nur 12219 consists of a short stem with two rosettes bearing juvenile pitchers with one of them showing a slightly branched spur, a feature that might have led this material to be identified, after Danser, as *N. ramispina*. We only examined this specimen from a photograph and could not confidently identify lid hairs, a diagnostic feature of *N. limiana*, because the resolution of the image was not sufficient. Moreover, in young pitchers the lid hairs are usually scarce and very thin. The leaves on the other hand are far too wide to fall within *N. ramispina* and are a good match for *N. limiana*, an identification we make with reasonable confidence here. If correct, this would make it the oldest known collection of *N. limiana*.

The distribution map for *Nepenthes ramispina* in Cheek & Jebb (2012: 259) indicates an outlying population of this taxon south of Kuala Lumpur. This appears to stem from confusion surrounding herbarium material of this species (e.g., Wyatt-Smith KEP 94568, KEP!) from Bukit Tunggul (1663 m), a peak to the east of the Batang Kali township and just north of the Genting Highlands, as the same toponym is applied to a hill of only 278 m elevation at 2°52.4'N, 101°44.9'E, corresponding to the location indicated on the map; there is no terrain in the surrounding region of suitable elevation to support this species.

Concluding remarks

The description of *Nepenthes batik* highlights the importance of Fraser's Hill as a hotspot of *Nepenthes* diversity, being home to some seven species, including two localised endemics in *N. batik* and *N. berbulu*. However, both the pitcher plants and the wider flora of the region face threats from direct and indirect human actions. Symbolic of this is the small population of *Dacrydium comosum* Corner (Podocarpaceae) conifers for which Pine Tree

Hill was (mis)named. This population, having been in decline for many decades (Kiew 1998: 4–5), is now thought to be represented by a single individual (WWF-Malaysia N.d.).

We close by echoing the words of Richard Holttum, the earliest known collector of *Nepenthes batik*: “Pine-Tree Hill has in fact a most remarkably interesting flora, and it is to be hoped that nature lovers will treat the plants upon it with respect.” (Holttum 1940: 43).

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Appendix – Additional specimens examined for this study

Nepenthes gracillima — G. Tahan, 3300 ft [≈1010 m], 29 May 1905, Wray & Robinson 5309 (**lectotype** SING! [#0046823], **isolecto-** BO! [#1298761]) [stem with three upper pitchers and badly damaged infructescence (lecto-), stem with three upper pitchers (two missing distal portions) and two badly damaged male inflorescences (isolecto-); identified as *N. gracillima* initially and by M. Jebb (BO, January 1995); both sheets labelled “*Nepenthes gracillima* Ridl. Type!” by B.H. Danser (August 1927); designated as lectotype of *N. gracillima* by Jebb & Cheek 1997: 43]; G. Tahan, no elevation data, July 1911, Ridley 16090 (K! [unnumbered]) [stem with upper pitchers and male inflorescence, stem with upper pitchers, infructescence, and inflorescence; identified as *N. gracillima* initially by H.N. Ridley and by M. Cheek (May 1999); NB: mixed collection—plant with infructescence belongs to *N. alba*]; G. Tahan, no elevation data, July 1911, Ridley 16096 (SING! [3 sheets: #0093954, 0093962 & 0093975]) [stem with lower pitcher (#0093954), separate leaves with lower pitchers (#0093962), stem with lower pitcher, separate leaf with lower pitcher (#0093975); identified as *N. macfarlanei* initially by H.N. Ridley and later by Jebb & Cheek 1997: 101, and as *N. gracillima* by C. Clarke (15 September 2011) and Clarke & Lee 2012: 48; sheets #0093954 and 0093962 tentatively identified as *N. macfarlanei* × *N. sanguinea* by B.H. Danser (August 1927; also Danser 1928:324)]; G. Tahan, Wray’s Camp, no elevation data, July 1911, Ridley 16174 (K! [unnumbered], SING! [#0093965]) [stem with large upper pitchers (K), stem with lower pitcher (SING); identified simply as “*Nepenthes*” initially by H.N. Ridley, (tentatively) as *N. gracillima* × *N. macfarlanei* by B.H. Danser (SING, August 1927; also Danser 1928: 299), as *N. gracillima* by B.H. Danser (K, 1930), M. Cheek (K, May 1999), C. Clarke (SING, 15 September 2011), and Clarke & Lee 2012: 48 (K, SING), as *N. macfarlanei* by M. Jebb (SING, January 1995), and as a mix of *N. macfarlanei* and *N. sanguinea* by Jebb & Cheek 1997: 101]; G. Tahan, top, no elevation data, July 1911, Ridley s.n. (SING! [#0093955]) [separate leaves with lower pitchers; identified simply as “*Nepenthes*” initially by H.N. Ridley, (tentatively) as *N. macfarlanei* × *N. sanguinea* by B.H. Danser (August 1927; also Danser 1928: 324), and as *N. gracillima* by C. Clarke (15 September 2011)]; G. Tahan, no elevation data, July 1911, Ridley s.n. (SING! [#0093968]) [stem with lower pitcher; identified as *N. sanguinea* initially by H.N. Ridley, as *N. macfarlanei* by M. Jebb (January 1995), and as *N. gracillima* by C. Clarke (15 September 2011)]; G. Tahan, 4000–6000 ft [≈1220–1830 m], 22 June 1922, Haniff & Nur 8306 (SING! [#0093958]) [leaf with lower pitcher only; identified as *N. macfarlanei* initially and later by Jebb & Cheek 1997: 99, (tentatively) as *N. macfarlanei* × *N. sanguinea* by B.H. Danser (August 1927; also Danser 1928: 92–93), and as *N. gracillima* by C. Clarke (15 September 2011) and Clarke & Lee 2012: 48]; G. Tahan, padang luas, c. 5000 ft [≈1520 m], 26 May 1923 [*sic*; presumably 26 June], Kloss FMS 12212 (BO n.v., L! [#1852456/0886021]) [branching stem with intermediate to upper pitchers; identified as *N. gracillima* by B.H. Danser (L, February 1929), Jebb & Cheek 1997: 45 (BO), Clarke 2001: 133 (BO), and Clarke & Lee 2012: 48 (BO)]; G. Tahan, 5000 ft [≈1520 m], 25 June 1923, Kloss FMS 12211 (BO n.v., L! [#1852452/0886028]) [leaf with upper pitcher only; identified as *N. gracillima* by B.H. Danser (L, 1929), M. Cheek (L, 1991), Jebb & Cheek 1997: 45 (BO), Clarke 2001: 133 (BO), and Clarke & Lee 2012: 48 (BO)]; G. Tahan, padang luas, no elevation data, 29 June [1923], Kloss FMS 12259

(SING! [#0094008]) [stem with lower pitchers; identified as *N. macfarlanei* initially and later by Jebb & Cheek 1997: 100 and as *N. gracillima* by C. Clarke (15 September 2011) and Clarke & Lee 2012: 48]; G. Tahan, ridge forest, 3500–4500 ft [≈1070–1370 m], 28 August 1928, Holtum S.20644 (BO n.v., SING! [#0093991]) [stem with lower pitcher, stems with upper pitchers, male inflorescence, and infructescences; identified as *N. gracillima* initially and later by Jebb & Cheek 1997: 45 (BO) and Clarke & Lee 2012: 48 (BO), as a mix of *N. gracillima* and *N. macfarlanei* by R.M. Som (SING, 13 March 1985), and as a mix of *N. alba* and *N. gracillima* by C. Clarke (SING, 15 September 2011) and Clarke & Lee 2012: 48 (SING); NB: mixed collection—small stem fragments with upper pitchers and floral material belong to *N. alba*]; G. Tahan, Tangga Duabelas [=Gunung Tangga Dua Belas or ‘Gunung Tangga 12’; 1679 m], 5000 ft [≈1520 m], 15 September 1937, Corner s.n. (L! [3 sheets: #1852530/0885967, 1852531/0885966 & 1852532/0885965]) [stem with lower pitcher (all sheets); identified simply as “*Nepenthes*” initially and as *N. macfarlanei* by M. Cheek (#1852530, February 1996); sheets #1852531 and 1852532 lacking provenance information beyond “Malaysia”; wood anatomy of #1852532 studied by Schwallier et al. (2017) under the name *N. macfarlanei*]; G. Tahan, ascent of, no elevation data, February 1961, Wong & Wyatt-Smith W60 (KEP! [#12925]) [stem with lower pitchers; identified simply as “*Nepenthes*” initially, as *N. macfarlanei* by L. Chua (15 May 1993) and M. Jebb (January 1995), and as *N. gracillima* by Clarke & Lee 2012: 48]; G. Rabong, path to, 2500–3300 ft [≈760–1010 m], 12 March 1972, Shah MS 2523 (A! [#01871272], KEP! [#13066], SING! [#0093940]) [stem with lower pitchers (A), two stems with lower pitchers, stem with male inflorescence (KEP), stem with upper pitchers and male inflorescence (SING); identified as *N. gracilis* (*sic*) initially, as *N. gracillima* by R.M. Som (SING, 11 November 1983), R. Kiew (SING, 17 April 2007), and M. Jebb (SING, January 1995), as *N. macfarlanei* by M. Jebb (KEP, January 1995), as *N. ramispina* by Jebb & Cheek 1997: 78 (SING), and as *N. sanguinea* by K. Imin (KEP, 16 January 2007)]; G. Tahan, trail to, ridge, 5000 ft [≈1520 m], 2 March 1973, Ng FRI 20961 (KEP! [#12926]) [stem with lower pitchers; identified simply as “*Nepenthes*” initially, as *N. macfarlanei* by M. Jebb (January 1995) and Jebb & Cheek 1997: 57, and as *N. gracillima* by Clarke & Lee 2012: 48]; G. Tahan, Kem Bonsai, campsite, unshaded, 4°37'N 102°13'E, 1690 m, 8 May 2008, Chew FRI 65305 (KEP! [#185771]) [stem with lower pitchers; identified as *N. sanguinea* initially]; G. Tahan, valley behind Kem Padang, unshaded, 4°35'N 102°14'E, 1600 m, 10 May 2008, Yao FRI 65338 (KEP! [#185783]) [stem with upper pitchers and developing inflorescence; identified as *N. gracillima* initially].

Nepenthes ramispina — Semangko Pass, 4560 ft [≈1390 m], 20 February 1904, Burn-Murdoch s.n. (L! [#1857161/0629735]) [stems with upper pitchers; identified as *N. reinwardtiana* (*sic*) initially, as *N. gracillima* by B.H. Danser (August 1927; also Danser 1928: 299), and as *N. ramispina* by Jebb & Cheek 1997: 78]; Semangko Pass, no elevation data, February 1904, Burn-Murdoch s.n. (SING! [#0094075]) [stem with upper pitchers; identified as *N. cf. gracillima* initially, as *N. gracillima* by B.H. Danser (August 1927; also Danser 1928:299), and as *N. ramispina* by Jebb & Cheek 1997: 78]; G. Ulu Semangko, top, no elevation data, August 1904, Ridley 12064 (**lectotype** SING! [#0046826], **isolecto-** K! [#000651558], SING! [#0046827]) [stem with upper pitchers and male inflorescence (lecto-), stem with lower pitchers

and stem with upper pitcher(s) and dehiscent infructescence (isolecto- K, SING); identified as *N. cf. gracillima* initially, as *N. gracillima* by B.H. Danser (SING, August 1927; K, 1930; also Danser 1928: 299, fig. 7) who recognised it as “Type of *N. ramispina* Ridl.” (SING), and as *N. ramispina* by M. Cheek (K, May 1999); designated as lectotype of *N. ramispina* by Jebb & Cheek 1997: 77; G. [Ulu?] Semangkok, 4000 ft [≈1220 m], April 1911, Ridley 15563 (SING! [#0094073]) [stem with upper pitcher, separate leaf with upper pitcher; identified as *N. gracillima* var. *major* initially, as *N. gracillima* by B.H. Danser (August 1927; also Danser 1928: 299, who corrected orthography to ‘*maior*’), and as *N. ramispina* by Jebb & Cheek 1997: 78]; G. Mengkuang, 5000 ft [≈1520 m], 12 January 1913, Robinson s.n. (SING! [#0094084]) [pitcherless rosette and climbing stem fragment; identified as *N. ampullaria* (sic) initially by H.C. Robinson, as *N. gracillima* by B.H. Danser (August 1927), and as *N. ramispina* by Jebb & Cheek 1997: 78]; G. Mengkuang Lebar, no elevation data, 13 January 1913, Robinson s.n. (SING! [#0094078]) [stem fragment with upper pitcher and male inflorescence, pitcherless stem fragment; identified as *N. sanguinea* initially by H.C. Robinson, as *N. gracillima* by B.H. Danser (August 1927; also Danser 1928: 299), and as *N. ramispina* by Jebb & Cheek 1997: 78]; G. Nuang, epiphyte, no elevation data, 12 May 1940, Symington 51798 (KEP! [#12995]) [stem fragments with upper pitchers; identified as “*Nepenthes* sp.” initially, as *N. gracillima* by L. Chua (15 May 1993) and M. Jebb (January 1995), and as *N. ramispina* by Jebb & Cheek 1997: 78 and C.L. Lim (4 January 2007)]; G. Nuang, summit, 4900 ft [≈1490 m], 12 May 1940, Symington 51814 (KEP! [#12994]) [stem with upper pitcher and dehiscent infructescence; identified as *N. gracillima* by J. Wyatt-Smith (29 April 1954) and M. Jebb (January 1995), and as *N. ramispina* by Jebb & Cheek 1997: 78 and C.L. Lim (4 January 2007)]; pressed with orchid identified as *Eria scortechinii* (= *Dilochiopsis scortechinii*) by J. Wyatt-Smith (29 April 1954); G. Bunga Buah, quartz ridge, 4200 ft [≈1280 m], 5 October 1958, Wyatt-Smith KEP 77685 (KEP! [#12974]) & 77686 (KEP! [#12973]) [stem with lower pitchers (77685), stems with lower and upper pitchers (77686); identified as *N. gracilis* (sic) initially by K.M.K., as *N. gracillima* by M. Jebb (January 1995), and as *N. ramispina* by Jebb & Cheek 1997: 78 and C.L. Lim (4 January 2007)]; Bukit Tunggul, mountain top, epiphyte, 5457 ft [≈1663 m], 15 May 1960, Wyatt-Smith KEP 94568 (KEP! [#12972]) [stems with upper pitchers and male inflorescence; identified as *N. trichocarpa* initially by J. Wyatt-Smith, as *N. gracillima* by M. Jebb (January 1995), and as *N. ramispina* by Jebb & Cheek 1997: 103 and C.L. Lim (4 January 2007)]; G. Bunga Buah, on open ground of mountain ridge, 4000 ft [≈1220 m], 3 February 1967, Burkill HMB 4339 (L! [#1857156/0886029], SING! [#0094077]) [stem with upper pitchers (both sheets); identified as *N. gracillima* initially and as *N. ramispina* by Jebb & Cheek 1997: 78 (SING) and C. Clarke (L, 21 August 2012)]; G. Ulu Kali, summit, in forest dominated by *Dacrydium*, 5000–6000 ft [≈1520–1830 m; sic!], 4 April 1968, Soepadmo HUM 9020 (KLU n.v., L! [#1857157/0885535]) [stem with upper pitchers; identified as indeterminate *Nepenthes* initially, as *N. gracillima* by A. Wistuba and J. Nerz (L, 14 October 1991), and as *N. ramispina* by Jebb & Cheek 1997: 78 (KLU) and V. Rybka (L, 17 August 2007)]; G. Ulu Kali, upper montane forest dominated by *Dacrydium comosum*, 5800 ft [≈1770 m], 24 March 1970, Davidson 1145 (L! [#1857160/0885532]) [stem with upper pitchers; identified as *N. gracillima* initially and as *N. ramispina* by V. Rybka (17 August 2007)]; G. Ulu Kali, near wireless station,

c. 5800 ft [≈1770 m] (SING) or 4500 ft [≈1370 m] (KEP), 11 June 1973, Shah & Ali MS 2958 (KEP! [#12987], SING! [#0094088]) [stem bearing upper pitchers with (SING) or without (KEP) developing inflorescence; identified as *N. sanguinea* initially, as *N. gracillima* by R.G. Shivas (SING, 9 January 1983), by L. Chua (KEP, 17 May 1993), and M. Jebb (KEP, SING, January 1995), and as *N. ramispina* by Jebb & Cheek 1997: 78 (KEP, SING) and C.L. Lim (KEP, 4 January 2007)]; G. Ulu Kali, summit, near wireless station, c. 4500 ft [≈1370 m] (KEP, #0094083) or c. 5000 ft [≈1520 m] (#0094085), 11 June 1973, Shah & Ali MS 2959 (KEP! [#12971], KLU n.v., SING! [2 sheets: #0094083 & 0094085]) [stem with lower pitchers (all sheets); identified as *N. sanguinea* initially, as *N. gracillima* by M. Jebb (all sheets, January 1995), and as *N. ramispina* by Jebb & Cheek 1997: 78 (KEP, KLU, SING) and C.L. Lim (KEP, 4 January 2007)]; Genting Highlands [NB: label erroneously titled “Flora of Fraser’s Hill”], ridge on right side of old highway, lower mountain forest, 4000 ft [≈1220 m], 15 November 1977, Kong & Hons. students 16 (SING! [#0365177]) [stem with lower pitchers; identified as *N. gracilis* (sic) initially and as *N. gracillima* by M. Jebb (January 1995)]; G. Ulu Kali, mossy forest, 4500 ft [≈1370 m], 6 March 1978, Kiew RK 233 (SING! [#0094080]) [stem with lower pitchers; identified as *N. gracillima* initially by R. Kiew and later by B.C. Stone (April 1979), and as *N. ramispina* by R. Kiew (17 April 2007)]; G. Ulu Kali, no elevation data, no date [presumably late 1970s], Kiew RK 640 (KEP! [#13113]) [stem with upper pitchers and male inflorescences; identified as *N. sanguinea* initially by R. Kiew and later by B.C. Stone (April 1979), and as *N. ramispina* by C. Clarke (18 March 2011)]; [G. Ulu Kali], radio station, no elevation data, no date [1980 or earlier], Weir s.n. (KEP! [2 sheets: #12998 & 13001]) [offshoots bearing lower and upper pitchers with (#12998) or without (#13001) male inflorescence; identified as *N. gracillima* initially and as *N. ramispina* by C.L. Lim (both sheets, 4 January 2007)]; [G. Ulu Kali], radio station, no elevation data, no date [1980 or earlier], Weir UPM 3023 (KEP! [2 sheets: both #13008]) [small rosette with pitchers (sheet 1), pitcherless stem with male inflorescence (sheet 2); identified as *N. gracillima* initially and as *N. ramispina* by C.L. Lim (both sheets, 4 January 2007)]; G. Ulu Kali, 6000 ft [≈1830 m; sic!], 30 March 1980, Rao s.n. (SING! [#0365179]) [stem with basal offshoot bearing lower pitchers; identified as *N. gracilis* (sic) initially, as *N. sanguinea* by S. bin Ahmad (13 June 1988), and as *N. gracillima* by M. Jebb (January 1995)]; G. Ulu Kali, beside the road, no elevation data, 16 June 1980, Kiew RK 981 (KEP! [#12997]) [stem with upper pitchers, separate male inflorescence; identified as *N. gracillima* initially by R. Kiew and as *N. ramispina* by C.L. Lim (4 January 2007)]; G. Ulu Kali, no elevation data, 22 December 1983, Som RMS 44 (KEP! [#13003]) & 45 (KEP! [#13000]) [small rosette with pitchers (44), stem fragment with upper pitcher (45); identified as *N. gracillima* initially and as *N. ramispina* by C.L. Lim (both sheets, 4 January 2007)]; [G. Ulu Kali], vicinity of Genting Hotel, elfin woodland, 3°25'N 101°45'E, 5000 ft [≈1520 m], 16 May 1987, Worthington 12795 (L! [#1857159/0885533]) [stem fragment with upper pitcher; identified as *N. gracillima* initially and as *N. ramispina* (possibly introgressed with *N. sanguinea*) by V. Rybka (17 August 2007)]; G. Bunga Buah, quartzite montane ericaceous forest, c. 1300 m, 18 January 1988, Saw FRI 36206 (L! [#1857154]) [stem with upper pitchers and male inflorescences; identified as *N. gracillima* by M. Cheek (20 February 1996) and as *N. ramispina* by M. Cheek (March 1999) and C. Clarke (21 August 2012)]; G. Ulu Kali, growing terrestrially on bare cut embankment, frequent in

one short stretch of road, no elevation data, 9 May 1991, *Tan et al.* TWK6 (SING! [#0094074]) [stem with lower pitchers; identified as *N. gracillima* initially and as *N. ramispina* by Jebb & Cheek 1997: 78]; G. Lau Tembakau [Lari Tembakau], mossy forest, 1650 m, 5 June 1991, *Chua et al.* FRI 34906 (KEP! [#13009]) [stem with upper pitchers and male inflorescences; identified as *N. gracillima* initially and later by M. Jebb (January 1995), and as *N. ramispina* by Jebb & Cheek 1997: 78 and C.L. Lim (4 January 2007)]; Genting Highlands, mossy forest, 1650 m, 5 June 1991, *Chua et al.* FRI 34907 (KEP! [#12979]) [pitcherless stem with female inflorescence; identified as *N. gracillima* initially and later by M. Jebb (January 1995), and as *N. ramispina* by Jebb & Cheek 1997: 78 and C.L. Lim (4 January 2007)]; summit ridge from G. Ulu Bakau to G. Rajah, upper montane forest, 5000 ft [≈1520 m], no date [likely early 1994], *Chua et al.* FRI 40515 (KEP! [2 sheets: both #12980]) [stem fragments with upper pitchers (both sheets); identified as *N. gracillima* initially and later by M. Jebb (January 1995), and as *N. ramispina* by Jebb & Cheek 1997: 78 and C.L. Lim (4 January 2007)]; G. Purun, upper montane forest, 6600 ft [≈2010 m; *sic*!], 16 February 1994, *Chua et al.* FRI 40520 (KEP! [#12982]) [stem with upper pitchers and male inflorescences; identified as *N. gracillima* by L. Chua (11 May 1994) and M. Jebb (January 1995), and as *N. ramispina* by Jebb & Cheek 1997: 98 and C.L. Lim (4 January 2007)]; G. Ulu Kali, primary lower montane forest, on ridge, creeping on rock, 3°26.21'N 101°47.11'E, 1707 m, 16 February 2007, *Julius* FRI 54895 (KEP! [2 sheets: both #144424]) [stem with intermediate pitchers (sheet 1), stem with upper pitchers and male inflorescences (sheet 2); identified as *N. ramispina* initially]; G. Ulu Kali, trail to small telecom station on left side of road, primary montane forest, 3°26.18'N 101°47.00'E, 1761 m, 12 September 2007, *Kiew* FRI 53759 (KEP! [#152532], SING! [#0124022]) [stem with upper pitchers and male inflorescence(s) (both sheets); identified as *N. ramispina* initially]; G. Ulu Kali, summit ridge, primary montane forest, unshaded, 3°25.0'N 101°46.5'E, no elevation data, 24 March 2008, *Yao* FRI 57904 (KEP! [2 sheets: both #150308], SING! [#0123354]) [stem with giant (up to c. 24 cm) upper pitchers (KEP sheet 1), pitcherless stem with inflorescence (KEP sheet 2), stem with lower pitchers (SING); identified as *N. ramispina* initially (all sheets)]; G. Ulu Kali, 3°25.07'N 101°47.23'E, no elevation data, 11 March 2009, *Sun Nra-1* (KEP! [#169081]) [stem with intermediate pitchers; identified as *N. ramispina* initially]; G. Ulu Kali, trail to Radio Amatur (Pulau Pinang) station, top, primary lower montane forest, slightly shaded, 3°26.18'N 101°47.05'E, 1770 m, 3 February 2010, *Imin* FRI 66477 (KEP! [#176809], L! [#4149139]) [stem with lower pitchers (KEP), stem with upper pitchers (L); identified as *N. ramispina* initially];

G. Bunga Buah, trail [to summit], primary lower montane forest, 3°22'N 101°44'E, 1200 m, 31 October 2010, *Yao* FRI 65498 (KEP! [#190762]) [stem with upper pitchers; identified as *N. ramispina* initially; NB: spur not ramified].

***Nepenthes sanguinea* (selected)** — G. Ledang [per Jebb & Cheek 1997: 79; =Mt. Ophir], no elevation data, no date [distributed to Kew in 1863–1864], *Griffith* 4441 (lectotype K! [3 sheets: #000651555, 000651556 & 000651557]) [pitcherless stem, separate intermediate pitchers (#000651555), stem with upper pitcher and female inflorescence, pitcherless stem with infructescence, separate female inflorescence (#000651556), pitcherless stem with two male inflorescences, separate pitcherless stem with developing inflorescence (#000651557); designated as lectotype of *N. sanguinea* by Jebb & Cheek 1997: 79]; Telom, no elevation data, November 1908, *Ridley* 13704 (SING! [unnumbered]) [stem with lower pitchers; identified simply as “*Nepenthes*” initially and later as *N. gracillima* var. *major* (both apparently by H.N. Ridley), as *N. gracillima* by B.H. Danser (August 1927; also Danser 1928: 299) and Jebb & Cheek 1997: 45, and as *N. ramispina* by R. Kiew (17 April 2007)]; Telom, no elevation data, November 1908, *Ridley* s.n. (SING! [2 sheets: #0094068 & 0094117]) [stem with upper pitcher (both sheets); identified as *N. sanguinea* initially, as *N. gracillima* by B.H. Danser (#0094068, August 1927; also Danser 1928: 299), and as *N. ramispina* by Jebb & Cheek 1997: 77 and S. Lee (#0094068, 8 July 2004)]; Pine Tree Hill, 4800 ft [≈1460 m], 27 August 1923, *Nur* 11057 (SING! [#0094072]) [stem fragments with upper pitchers; identified as *N. sanguinea* initially, as *N. gracillima* by B.H. Danser (August 1927; also Danser 1928: 299) and M. Jebb (January 1995), and as *N. ramispina* by Jebb & Cheek 1997: 78]; Taman Sedia, Ulu Telom, 30 August 1931, *Jaamat* 27665 (KEP! [#12993]) [stem fragments with upper pitchers, separate infructescence; identified as *N. sanguinea* initially (later changed to *N. gracillima*), as *N. gracillima* by M. Jebb (January 1995), and as *N. ramispina* by Jebb & Cheek 1997: 78 and C.L. Lim (4 January 2007)]; Bukit Kamunting [Road], [Cameron Highlands], hill top ridge, stunted scrub, 5300 ft [≈1620 m], 9 October 1961, *Burkill* HMB 2847 (L! [#1852457/0886022], SING! [#0094138]) [stem with upper pitchers and infructescence (both sheets); identified as “*Nepenthes* (?) *gracillima*” initially by H.M. Burkill and as *N. sanguinea* by M. Jebb (SING, January 1995)]; G. Besar Hantu, summit, primary lower montane forest, 3°13.27'N 102°00.29'E, 1102 m, 5 May 2010, *Mohd Hairul* FRI 70980 (KEP n.v., SAN! [#72029]) [stem with upper pitchers; identified as *N. gracilis* (*sic*) initially].