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Nepenthes section *Insignes* in Indonesia, with two new species

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Key words

Biak
Critically Endangered
endemic
limestone
Papua Barat
Raja Ampat

Abstract A review of new data relating to *Nepenthes insignis* in Indonesia indicates that three taxa in section *Insignes*, not one, are present in New Guinea. One of these, endemic to the limestone of the island of Biak, is formally named as *Nepenthes biak* and assessed as Critically Endangered; the other, from limestone of the Raja Ampat islands is provisionally distinguished as *Nepenthes* sp. Raja Ampat, since only images are available.

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INTRODUCTION

This paper is one in a series leading to a monograph of the genus *Nepenthes* building on a skeletal revision of the genus (Jebb & Cheek 1997) and the account for Flora Malesiana (Cheek & Jebb 2001). While in 2001 only 85 species were accepted for the genus, today the figure lies at approximately 150. In 2013, 12 new species were published from the Philippines alone (Cheek & Jebb 2013a–g). In the last few years our attention has focussed on Indonesia, with new species described from Halmahera (Cheek 2015) and Sulawesi (Cheek & Jebb 2016a–b). Here we describe a new species from New Guinea, the first published from that island since 2011 (Robinson et al. 2011: 543).

Danser (1928:314) described *N. insignis* Danser, type species of sect. *Insignes* Danser, from the then Netherlands Indies, based on two specimens from the mainland of New Guinea, both from current Papua Province of Indonesia, N and S of the central highland range (Jebb 1991). The species of sect. *Insignes* are otherwise confined to the Philippines apart from a questionable outlier in Borneo (Cheek & Jebb 2001). *Nepenthes insignis* was refound in the wild by Rischer (1995) who noted that it also occurs on Biak, an offshore island to the North: "the plants correspond in all respects but are generally somewhat smaller". (Rischer 1995). We accepted this statement in our skeletal revision of *Nepenthes* (Jebb & Cheek 1997). It appeared to be supported by a specimen at L from Biak *Kostermans & Soegeng 936* (Jebb & Cheek 1997). However, at the time, we did not examine the specimen in sufficient depth.

This oversight was perpetuated in Cheek & Jebb (2001). Subsequently, the 'Biak variant' of *N. insignis* has been photographically recorded in the wild by several *Nepenthes* enthusiasts, including Andreas Wistuba (https://www.wistuba.com/nepenthes/new-guinea/lowland/nepenthes-insignis-biak-irian-jaya.php, accessed 31 Aug. 2017) and Alfindra Primaldhi (http://www.arkive.org/pitcher-plant/nepenthes-insignis/image-G116821.html, accessed 31 Aug. 2017). McPherson (2009: 1061) echoed and amplified Rischer's (1995) statement "The populations of *N. insignis* on Biak differ from those on mainland Papua in that they produced pitchers and leaves which are shorter and narrower than their mainland counterparts. The lamina is up to 26 cm long and 5 cm wide, and the pitchers are up to two-thirds the size of the mainland plants, as well as generally narrower. The coloration of the Biak plants is usually lighter and the upper pitchers often lack red pigmentation entirely. In all other respects, the plants on Biak are identical to the plants on Papua".

During a recent field visit to Indonesian New Guinea in June 2017, we had the opportunity to review data on *Nepenthes*, including *Nepenthes insignis*. The photographic data of the 'Biak variant' showed that the upper pitchers are constricted at the midpoint, quite unlike those of the *N. insignis* records from the mainland, which are infundibuliform (funnel-shaped) as well as being more massive and stout. Inspection of the climbing stems shown in the online photographs referred to above showed two other characters separating the Biak variant of *N. insignis* from that of the mainland population: 1) the stems are cylindrical, not triangular in section; and 2) the leaf blades are amplexicaul, not long-decurrent as wings for most of the length of the internode. Subsequently, we confirmed these point of difference in the Leiden duplicate of *Kostermans & Soegang 936*, and in cultivated material from Biak at Kew (*Cheek 18785*).

These characters are more than sufficient to justify separate species-status for the Biak plants, named in this paper as *Nepenthes biak*. Characters separating *N. biak* from *N. insignis* are presented in Table 1.

An interesting feature of *N. biak* is that photos in the wild show both heavily purple-blotched upper pitchers, and, for example on parts of the stem which have inflorescences, pure yellow upper pitchers. This same feature is seen in cultivated material at Kew. In fact, this species has dimorphic and dichromic upper pitchers, referred to in the description below as primary upper pitchers (those which are produced first, with purple blotches) and secondary upper pitchers (those produced further up the climbing stems).

Plants attributed to the 'Biak variant' were photographed in the Raja Ampat islands to the west of Indonesian New Guinea by Yin (2016) on an 'ecotourist' trip led by Chien Lee. These undoubtedly represent a further new species to science, and

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Table 1 Characters separating *Nepenthes insignis* from *N. biak.*

	Nepenthes insignis	*Nepenthes biak*
Stems	Triangular in section	Cylindrical
Leaves of climbing stems – decurrent to node below?	Yes	No (rarely decurrent by < 1/10 the length of the internode)
Upper pitcher shape	Infundibuliform	Cylindrical-narrowly constricted in middle (frontal view)
Lid length : breadth ratio	c. 1 : 1	c. 4 : 3
Spur apex	Entire, acute	Shortly bifurcate
Coloration of upper pitchers (lowermost)	Yellow-green, lacking purple blotches	Yellow-green, heavily blotched with purple
No. longitudinal nerves on each side of the midrib	4–6	2(–3)
Inner edge of peristome (upper pitcher)	Shortly toothed	Teeth absent

the third species of sect. *Insignes* from Indonesia. This taxon is included in the key below as *N*. 'Raja Ampat'. Unfortunately, in the absence of an herbarium specimen, it cannot formally be named.

MATERIALS & METHODS

The methods used in this paper are as those documented in Cheek & Jebb (2013a–g). Materials used were images accessed online (at the sites indicated in the text above), the specimens studied and cited at K, BO and L, and three live plants at the Tropical Nursery, RBG Kew, derived from seed collected on Biak in the 1980s by Robert Cantley (Borneo Exotics) and later donated to RBG Kew in 2002 and 2003, as *N. insignis.* These have the accession numbers 2003-2747 (one plant) and 2002-896 (two plants). From the last, herbarium specimens were made that form the nomenclatural type of *N. biak.* Herbarium citations follow Index Herbariorum (Thiers et al. continuously updated) and binomial authorities IPNI (continuously updated). The conservation assessment was made using the categories and criteria of IUCN (2012). Herbarium material was examined with a Leica Wild M8 dissecting binocular microscope fitted with an eyepiece graticule measuring in units of 0.025 mm at maximum magnification. The drawing was made with the same equipment using Leica 308700 camera lucida attachment.

KEY TO THE INDONESIAN SPECIES OF NEPENTHES SECTION INSIGNES

1. Plants terrestrial, of coastal limestone cliffs of offshore islands, upper pitchers slender, length : breadth ratio > 5 : 1; stems terete 2
1. Plants predominantly epiphytic in forest along rivers, sometimes terrestrial, but not recorded on limestone; mainland New Guinea; upper pitchers massive and stout, length : breadth ratio 3–3.5 : 1; stems triangular . . . . . *N. insignis*
2. Upper pitchers long and narrowly infundibuliform; leaf blades of climbing stems decurrent as wings for c. 1/2 the internode below . . . . . *N.* sp. Raja Ampat
2. Upper pitchers cylindric, constricted slightly at midpoint (at least in frontal view); blades of climbing stems not decurrent, or decurrent for < 1/10 the internode below. . . . . *N. biak*

Nepenthes biak Jebb & Cheek, *sp. nov*. — Fig. 1

Differs from *N. insignis* Danser in the upper pitchers in frontal view slightly constricted in the middle (not funnel-shaped); stems cylindrical (not triangular in section) leaves clasping stem (not decurrent down the stem as wings to the node below). — Type: *Cheek 18785* (holotype MAN; isotypes BO, K, L), 25 Aug. 2017, cultivated at RBG, Kew (2002-896) from plants donated by Robert Cantley, origin Biak Island.

Etymology. Named for the island of Biak (noun in apposition).

Terrestrial climber to at least 3 m tall, indumentum of scattered red sessile glands 0.05 mm diam, inconspicuous, on all outer surfaces, glabrous apart from the tendril and pitcher (and proba-bly the inflorescence). *Rosette stems* with lower pitchers only known from a photograph. *Short stems* not strongly differentiated from climbing stems, with internodes cylindrical 6–7 mm diam, 2.5–4 cm long. *Climbing stems* as short stems, internodes 5 mm diam (hydrated material), 5.8–9 cm long, axillary buds not conspicuous. *Leaves* of short stems spirally inserted, glossy, leathery, linear-narrowly oblanceolate, apex rounded-acute, not peltate, base gradually attenuate, broader than stem, clasping the stem for 3/5 its circumference, shortly decurrent for 2–7 mm. *Longitudinal nerves* 2(–3) pairs on each side of the midrib in the outer half, pennate nerves numerous, arising at c. 60° from the midrib; nerves conspicuous only in dried specimens. Leaves of climbing stems as short stems, but generally shorter and narrower 16.4–17.5(–26.5) by 2–2.9(–4.8) cm. Lower pitchers (tendril vertical, uncoiled; fringed wings) seen only in photos of seedlings in the wild – small ovoid-cylindric. *Intermediate pitchers* (tendril arising laterally from pitcher base, uncoiled) variable in shape and size, from those resembling the lower pitchers in being partly with fringed wings, etc. to those which are larger, resembling the primary upper pitchers. Intermediate pitchers resembling lower pitchers ovoid-cylindric 4.5–8.5 cm high, 1.8–3.5 cm wide at base, tapering to 1.4–2 cm wide below peristome; fringed wings (rarely present only in smallest pitchers) c. 1 mm wide, fringe elements c. 2 mm long, 2 mm apart. Mouth ovate, peristome green, 1.2 mm diam; lid ovate, c. 1–1.5 cm diam. *Upper pitchers* (mouth facing away from the coiled tendril) dimorphic and dichromic, the lowermost 2–4 (primary) larger and heavily blotched with purple over a green background, the peristome uniformly purple; the uppermost (secondary) small, almost pure yellow. Upper pitchers overall ± cylindrical in side view, gradually laterally constricted in the middle in frontal view, fringed wings absent reduced to ribs that are increasingly thickened and mechanical towards the base in lower half of the pitcher, extending as flanges around the curve of the base and up the tendril. *Lowermost (primary) upper pitchers* 19–23 cm high, in side view 3.2–3.6 cm wide at midlength, 3.5–4.2 cm wide near base, 4.0–4.5 cm wide below peristome; in frontal view 2.5–2.9 cm wide at midlength, 3.5 cm wide near base, 4.0–4.1 cm wide below peristome; ribs c. 1.7 cm apart below peristome, extending to 2.5 cm apart near base, indumentum of sparse, c. 1 % cover, of simple translucent brown 4–5-celled acute stiff hairs 0.15–0.4 mm long, mixed with red sessile glands 0.025–0.05 mm diam, about 3 % cover. Mouth ovate-elliptic 40–60 mm interior length by 23–38 mm width, oriented at 45° from the horizontal, straight, not curved until the dorsal 1/10 which is abruptly erect forming a short, ill-defined column. Peristome dark glossy purple, subcylindrical in section 5 mm wide in frontal part, 7 mm wide towards the column, outer edge undulate, rigid, with about 5 pointed, rigid lobes on each side, mainly held flat

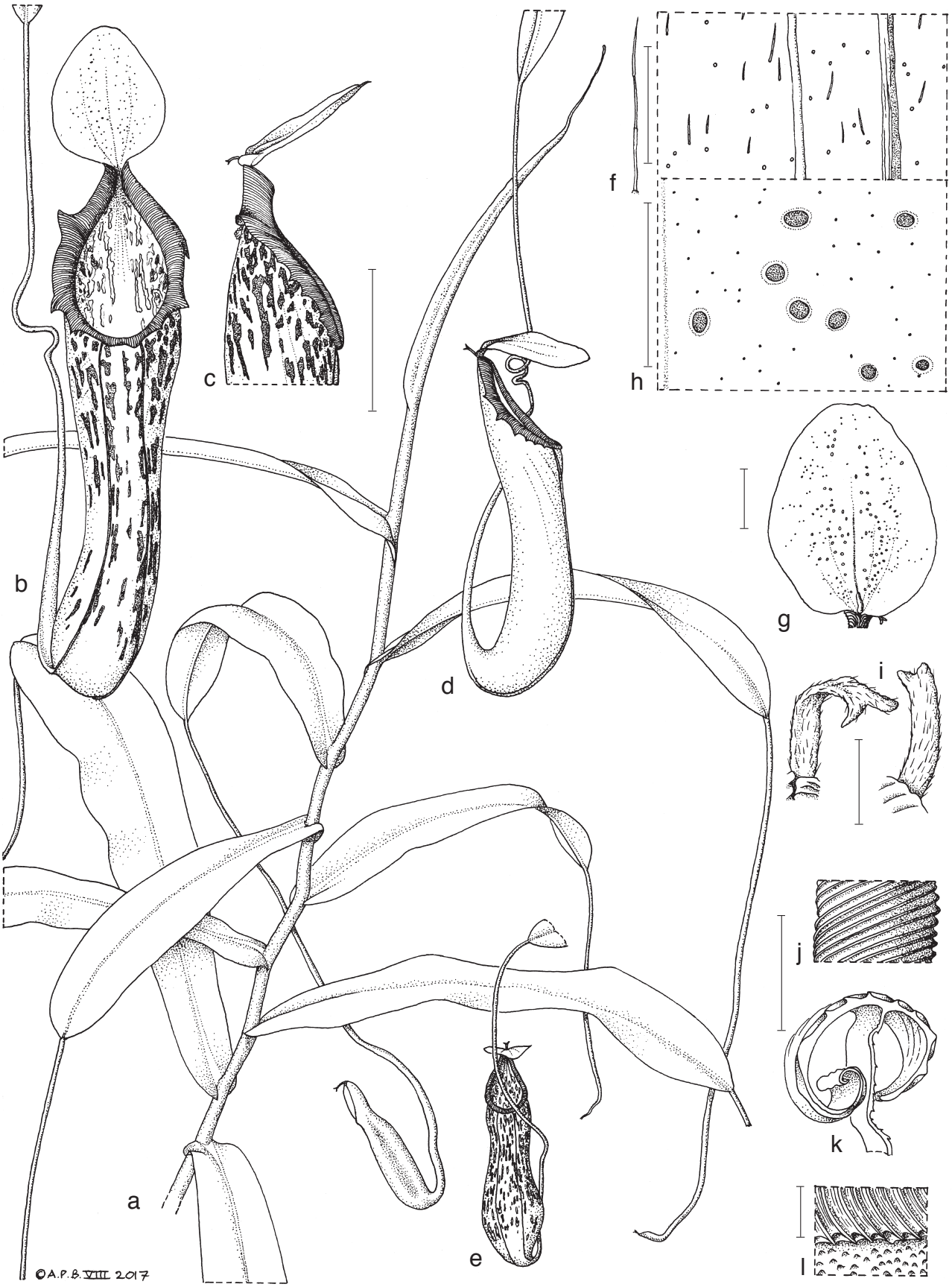

Fig. 1 *Nepenthes biak* Jebb & Cheek. a. Habit, climbing stem; b. primary upper pitcher, frontal view; c. side view of pitcher mouth of b; d. secondary upper pitcher; e. intermediate pitcher; f. indumentum of exterior of upper pitcher; g. lower surface of lid; h. detail of lower surface of lid showing nectar glands; i. spurs of upper pitchers; j. view of peristome (upper pitcher), from above; k. transverse section of peristome from j; l. inner surface of peristome from j. — Scale bars: a–c, e = 5 cm; f, h, l = 1 mm; g = 1 cm; i = 2 mm; j–k = 5 mm. — Drawn by Andrew Brown from live material of Kew (accession 2002-896), subsequently preserved as *Cheek 18785*.

against the pitcher wall, but some patent, variable in length, 1–5 mm long, inner edge lacking teeth and directed towards pitcher wall; ridges conspicuous, 0.3–0.35 mm apart, c. 0.2 mm high; lid ovate-elliptic (3.5–)4–5.8 by (2.9–)3–4.7 cm held about 45° above the horizontal, apex rounded-truncate, base truncate, basal appendages absent, upper surface lacking hairs but with sessile red glands on the upper surface, with a pair of low, curved ridges each side of the midline, corresponding on the lower surface with two arced bands of 80–130 nectar glands on each side of a gland-free midline band 5–6 mm wide, the marginal 5–7 mm also lacking nectar glands; nectar glands orbicular or transversely elliptic, drying purple, surrounded by a low crater-like yellow wall 0.25–0.5 mm by 0.15–0.25 mm, entire lower surface with scattered minute red globose glands 0.05 mm diam. Margin of lid width minute erect branching hairs 0.05–0.1 mm high in a dense line. Spur patent, curved downwards, dorsiventrally flattened 7.8 mm long, apex forked, the lobes acute, c. 0.5 mm long. *Uppermost (secondary) upper pitchers* as the primary except, 12.5–13.5 cm high, in side view 2.6–3 cm wide at middle, 2.8–3.2 cm near the base and 2.6–3 cm wide below the peristome; in frontal view 1.6–1.8 cm at middle, 2.3–2.5 cm wide near base, and 2.5–3.5 cm wide below the peristome, ribs c. 1.7 cm apart below peristome, 2.5 cm apart towards base. Mouth 36–45 mm interior length, 25–32 mm wide. Peristome yellow, 4 mm wide in frontal part, 5 mm towards column; lobes 5–7(–9) on each side; lid 3.6–4.8 by 3–4 cm. *Inflorescences* and *infructescences* unknown.

Distribution & Ecology — Limestone coastal cliffs in the lowland evergreen forest zone – sometimes epiphytic on mangrove trees. Endemic to Biak Island; sea-level.

Additional specimen. Indonesia, New Guinea, Biak Island, near Parieri, 12 Sept. 1966, *Kostermans & Soegeng-Reksodihardjo 936* (L, http://data.biodiversitydata.nl/naturalis/specimen/L.1852584, image viewed online).

Conservation — McPherson (2009: 1061) states “the once widespread populations of *N. insignis* on Biak are severely threatened by intensive poaching by locals who sell wild-collected plants to tourists briefly visiting Biak on cruise ships. I witnessed such poaching of plants at first-hand, and believe that most of the accessible populations in Biak are severely threatened or already destroyed. Since there is no local infrastructure or government interest to protect these plants, the outlook for these unique populations on Biak is poor”.

It seems likely that *N. biak* should be assessed as Critically Endangered given the single location (Biak) and the threats stated by McPherson above, according to Criterion D of IUCN (2012).

Biak, about 70 by 30 km in size and, with a population of over 100 000 persons, is relatively densely populated. It is reported as having been extensively logged in colonial times. Forest has also been cut down to clear land for planting (Wikramanayake 2002: 551). *Nepenthes biak* has been recorded from the south-eastern part, both along coastal cliffs and at least 1 km inland (e.g., *Kostermans & Soegeng-Reksodihardjo 936*, L). It is not known how far over the island the range of the species extends (or extended). If this species is to survive in the wild, surveys to collect such data are advisable, so that a management plan for the species might be devised. This would include awareness raising for the local population, a possible propagation programme to meet the demand for live plants, and measures to protect the plant at one or more sites in the wild. It is not known if the only protected area on Biak, the Biak Utara Nature Reserve, close to the bridge with Supiori Island, contains *N. biak*, nor in fact whether indeed the species extends to Supiori Island, or the other islands in the Kepulauan Biak (also known as the Schouten, formerly Geelvink) group, which include Numfoor. Biak lies about 150 km from the mainland.

The biogeography of Biak

Is it surprising that a relatively small island, not far off the northern coast of New Guinea (Papua) be the home of a unique *Nepenthes*? Beehler (2007: 200) recognises 13 biogeographic units for Papua. He states:

“Biak/Numfoor

These oceanic islands constitute the most distinct unit [of the 13 biogeographic units of Papua]. This oceanic unit shows no real affiliation with neighbouring units. Nearby Yapen shows no biogeographic affinities with this unit, in spite of its proximity and insular nature.

Many insular avian endemics were treated as races of more widespread forms by Mayr (1941) thus hiding the extent of this unit’s uniqueness. At least 12 bird and four mammal species are endemic.”

Knowledge of plant species in Papua is so incomplete that Beehler was not able to draw upon any data for his paper. One of the best studied groups are the palms (*Palmae* or *Arecaceae*). Although there is no overview of palm biogeography for Papua, the palm flora of Biak has been studied by Baker & Heatubun (2012). Among the 19 species that are recorded, four are endemic to Biak-Supiori, *Hydriastele dransfieldii* W.J.Baker & Heatubun, *Hydriastele biakensis* W.J.Baker & Heatubun, *Heterospathe porcata* W.J.Baker & Heatubun, and it has recently been revealed that the fourth endemic species to Biak is an endemic (unique) monotypic genus, *Manjekia* W.J.Baker & Heatubun. This latter species is traditionally used for floorboards and pillars in house construction on Biak, but is now Endangered (Heatubun et al. 2014). Undoubtedly, additional Biak-endemic plant species will be discovered as the botanical knowledge of Papua increases.

Dimorphism in upper pitchers

Dimorphic and dichromic upper pitchers were first reported in *Nepenthes* in Cheek et al. (2015) regarding *N. barcelonae* Tandang & Cheek, another member of sect. *Insignes*. The same nomenclature is used here, the first formed upper pitchers ‘primary upper pitchers’, and those further up the climbing stems ‘secondary upper pitchers’. While in *N. barcelonae* the primary upper pitchers are red, larger and more stout than the green, smaller and more slender secondary upper pitchers, so in *N. biak* the primary upper pitchers are also more large and stout, but are heavily blotched purple over a green background, with a purple peristome, while in the secondary upper pitchers they are a uniform yellow. The dimorphism is less extreme than in *N. barcelonae* where the tendrils are uncoiled in the primary upper pitchers but coiled in the secondary upper pitchers. In *N. biak* the tendrils are coiled in both primary and secondary upper pitchers.

As in *N. barcelonae* we can speculate that a possible functional basis for this dimorphism is that the primary pitchers fulfil the function of lower pitchers (trapping ground-dwelling insects) while the secondary pitchers function as those of conventional upper pitchers (catching flying insects). As in that species, we suggest that the dimorphism arose after the loss or reduction of lower pitchers in an evolutionary lineage present within sect. *Insignes*. As in *N. biak*, in several other species of sect. *Insignes*, such as the widely cultivated *N. ventricosa* Blanco and *N. burkei* Mast., lower pitchers are either produced very briefly, or not at all, and in fact are not reliably recorded. However, in the Mindanao species within the sect. *Insignes*, represented by *N. merrilliana* Macfarl., *N. surigaoensis* Elmer and *N. bellii* K.Kondo, lower pitchers are normally produced.

When mature plants of *N. biak* in cultivation at Kew produce new shoots from the rootstock, the resultant rosette shoots

produce no lower pitchers but only intermediate pitchers. Similarly, when the stem apex was removed 1.5 m from the ground, shoots developed from the climbing stem which also produced intermediate pitchers (tendril uncoiled, arising laterally on the pitcher).

Taxonomic affinities

The taxonomic affinities of *N. biak* appear to be with *N.* sp. Raja Ampat and with *N. insignis* itself. All three species share the synapomorphy of a rib pair in the upper pitchers which, while weakly developed below the peristome, becomes pronounced in the middle and especially the lower part of the pitcher and the transition into the end of the tendril, making these areas triangular in section. This feature is not recorded elsewhere in sect. *Insignes.*

Cultivation

While *N. insignis* from the mainland is reported to be challenging to cultivate, cultivation of the 'Biak variant', i.e., *N. biak*, is straightforward, as it is growing well in normal conditions for lowland *Nepenthes.* It is available for sale online in Europe.

The discovery of *N. biak* and *N.* sp. Raja Ampat increases the numbers of species known for sect. *Insignes* from 12 to 14. The remaining species, all in the Philippines except the questionable *N. northiana* Hook.f. in Borneo, are *N. ventricosa*, *N. burkei*, *N. merrilliana*, *N. surigaoensis*, *N. bellii*, and, more recently discovered, *N. sibuyanensis* Nerz (Nerz et al. 1998), *N. alzapan* Jebb & Cheek (Cheek & Jebb 2013d), *N. samar* Jebb & Cheek (Cheek & Jebb 2013f), *N. aenigma* W.Suarez & Calamero (Gronemeyer et al. 2016) and *N. barcelonae* Tandang & Cheek (Cheek et al. 2015).

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