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Pitcher Plants (*Nepenthes*) Recorded from Keningau-Kimanis Road in Sabah, Malaysia

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Abstract: A dichotomous key and morphological descriptions and photographs of three species of pitcher plants recorded from Sabah were given. *Nepenthes curtisii* ssp. *zakriana* Adam and Wilcock is elevated to species level that is *Nepenthes zakriana* (Adam and Wilcock) Adam and Hafiza. A new species, *Nepenthes naquiyuddinii* Adam and Hafiza is described.

Key words: Morphological descriptions, pitcher plants, Sabah, *Nepenthes*, species composition

INTRODUCTION

Pitchers plants of the tropical rain forest in Sabah belong to the genus *Nepenthes*. The genus is found in the tropical region of the world with centre of distribution in Borneo, New Guinea, Peninsula Malaysia, Philippines and Sumatra. Its distribution extends eastwards up to Isles of Pines, westwards to Sri Lanka, Seychelles and Madagascar but absent on the mainland of African continent, southwards it can be found growing in the subtropical region of York Peninsula in Queensland Australia, northwards to Khasia Hill in Assam, Indo-China and Southern China. Pitcher plants are climbers or scramblers. They are commonly terrestrial plants but some species may grow epiphytically on tree trunk or branches. *Nepenthes veitchii*, recorded only from Borneo is only known species grows as epiphyte. The pitcher plants can be easily recognized in the field by the presence of pitchers on tendril tips of both upper and lower stems. The plants are dioecious, male and inflorescence are borne on different plants. The nectar glands on upper surface of flower sepals secreted nectar; nectar emitted foetid smell to attract insects mainly ants and flies. Pitcher plants can grow on low nutrient soil (Adam, 2002) for example on sandy soil. They can thrive in these habitats by the ability of pitchers to trap preys mainly insects and digested them by fluid secreted by digestive glands found on inner wall of pitcher cavity (Adam, 1997).

Key to species of *Nepenthes* from Keningau-Kimanis Road in Sabah

- Inner pitcher cavity of upper pitchers partly glandular; shape of upper stem angular; leaves base extended into two wings or decurrent 2
- Inner pitcher cavity of upper pitchers wholly glandular, shape of upper stem cylindrical, leaves base semi-amplexicaul. ..... *Nepenthes zakriana*
- Leaves sessile, leaves base forming two wings extended over the entire length of one internodes, two big spots present on inner wall of pitcher cavity of both upper and lower pitchers ..... *Nepenthes reinwardtiana*
- Leaves shortly petiolate, leaves base forming two wings and extended up to 2 cm into one internodes, two big spots absent on inner wall of pitcher cavity of both upper and lower pitchers ..... *Nepenthes naquiyuddinii*

MORPHOLOGICAL DESCRIPTIONS

***Nepenthes naquiyuddinii* Adam and Hafiza species nova:** Caulis inferiore cylindricis, 4 mm lata, internodiis 0.5-2 cm longa, folia elliptica et lanceolata, 4-13 cm longa, 1-3.5 cm lata, basi obtusa attenuatta in similis petiola, leviter decurrens, apicis acuta, petioli 1-3 cm longa, nervi longitudinalis 2-3 quoque latus, cirrhus ad 20 cm longus. Caulis superiore angularis, 3-4 mm lata, internodiis 0.5-4 cm longa, folia elliptica, lanceolata, oblonga et oblanceolata, 7-14 cm longa, 1.5-3 cm lata, basi obtusa attenuata in similis petiola, leviter decurrens apicis acuta, sessilifolius vel subsessilifolius, petioli ad 1 cm longa, nervi longitudinalis 2-3 quoque latus, cirrhus ad 22 cm

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Fig. 1: *Nepenthes naquiyuddinii* Adam and Hafiza showing upper pitchers with prominent midrib on lower lid surface

Fig. 2: Upper pitcher of *N. naquiyuddinii* Adam and Hafiza (middle) has close resemblance with *N. reinwardtiana* Miquel but with no green spots

longa. Ascidia inferiore: tubularis parte 1/3 superiora, ventricosa parte 2/3 inferiora, 14-15 cm longa, 3-4 cm lata, costis 2 prominentibus, os ovata, horizontalis anticus et elevatus in operculum, 4-5 cm longa and 3-4 cm lata, peristomium cylindricum, 2-3 mm lata, magines interiore dentibus, costis conspicuis; operculum ellipticum, 3.5-4 cm longa, 2-3 cm lata, facie inferiore costis prominentibus, calcar cylindricus, nonramus. Ascidia superiore: tubularis parte 1/3 superiora, infundibularis parte 2/3 inferiora, 13-15 cm longa, 2-3 cm lata, costis 2 prominentibus, os ovatum, horizontalis anticus et elevatus in operculum, 3-6 cm longa et 1.5-23 cm lata, peristomum cylindricum, 2-3 mm lata, margines interiores dentatus, costis conspicuis; operculum ellipticum, 3-3.5 cm longa, 1.5-2 cm lata, facie inferiore costis distincti, calcar cylindricus,nonramus. Inflorescentia mascula racemosa, pedicelli fere 2-floris, raro 1-floris, Inflorescentia feminei ignota (Fig. 1 and 2).

Type specimens: Jumaat H. Adam, JHA8016, Sabah, Keningau-Kimanis Road, Taman Banjaran Crocker, N05'27.452' and E116'02.422', 30th April 2003, Altitude 1400 m. 4 Holotype (UKMB:Upper stem with male inflorescence); Isotype (UKMB: Upper stem with upper pitchers and lower stems with lower pitchers); Growing on roadside in secondary vegetation.

Lower stem: Cylindrical, 4 mm thick, internodes 0.5-2 cm long; leaves elliptic and lanceolate, 4-13 cm long, 1-3.5 cm wide, base obtuse attenuate into petiole and slightly decurren, petiole attachment at the base forming two wing and extend up to 1.5 cm into one internodes, apex acute, petiole 1-3 cm long, longitudinal nerves 2-3 each side, tendrils without pitcher uncurled 4 cm long, tendrils with pitchers 15-20 cm long. Upper stems: Angular, 3-4 mm thick, internodes 0.5-4 cm long, leaves elliptic, lanceolate, oblong and oblanceolate, 7-14 cm long, 1.5-3 cm wide, base obtuse and attenuate into petiole and winged extended 0.5-2 cm into internodes, apex acute, petiole sessile or shortly petiole up to 1 cm long, longitudinal nerves 2-3 pairs, tendrils with no pitchers curled, 8-12 cm long, tendrils with pitchers 19-22 cm long. Lower pitchers: Tubular on upper 1/3, ventricose on lower 2/3 portion, 14-15 cm long, 3-4 cm wide on tubular region, 3-4 cm wide on lower ventricose region, 2 prominent ribs running over whole length, mouth ovate, horizontal in front and elevated towards the lids, 4-5 cm long and 3-4 cm wide, peristome cylindrical, 2-3 mm thick, inner peristome margin with short peristome teeth, peristome ribs conspicuous, inner surface of pitcher partly glandular, glands overarched; lid elliptic, 3.5-4 cm long, 2-3 cm wide, underneath entirely covered with small nectar glands, midrib distinctly elevated and running up to entire length, basal portion of midrib not developed into glandular crest,

spur cylindrical, simple and inserted on lid base Upper pitchers: Tubular on upper 1/3, infundibulate on lower 2/3 portion, 13-15 cm long, 2-3 cm wide on tubular region, 2-3 cm wide on lower infundibulate region, 2 prominent ribs running over whole length, mouth ovate, horizontal in front and elevated towards the lids, 3-6 cm long and 1.5-23 cm wide, peristome cylindrical, 2-3 mm thick, inner peristome margin with short peristome teeth, peristome ribs conspicuous, inner surface of pitcher partly glandular, glands overarched; lid elliptic, 3-3.5 cm long, 1.5-2 cm wide, underneath entirely covered with small nectar glands, midrib distinctly elevated and running up to entire length, basal portion of midrib not developed into glandular crest, spur cylindrical, simple and inserted on lid base Male inflorescence: Raceme; peduncle 5-12 cm long, rhachis 14-22 cm long; pedicels almost all 2-flowered, rarely 1-flowered and always towards the tip. Female inflorescence: unknown

Specimens examined: Aminah Anting 4, Sabah, Keningau-Kimanis Road, Taman Banjaran Crocker, N05'26.705 and E116' 14.892, 19th August 2003, Altitude 1424 m: Jumaat H. Adam, JHA8019, Sabah, Keningau-Kimanis Rd. Taman Banjaran Crocker, 30th April 2003, Altitude: 1400 m Growing on roadside in secondary vegetation (UKMB).

Derivation of name: This species is name after National University of Malaysia (UKM) Pro-Chancellor, Yang Amat Mulia Tunku Laxamana Tunku Dato' Seri Utama Naquiyuddin Ibni Tuanku Ja'afar, The Prince of UKM Chancellor, Duli Yang Maha Mulia Yang Di-Pertuan Besar Negeri Sembilan Darul Khusus, Tuanku Ja'afar Ibni Almarhum Tuanku Abdul Rahman.

Distribution: Sabah
Altitude: 1400-1424 m

Notes: *Nepenthes naquiyuddinii* belong to highland species group since it is recorded from 1400-1424 m above sea level. It is found growing along the roadside in open secondary vegetation but failed to grow in heavy shaded area of this secondary vegetation and in tall canopy primary forest. Our field observation showed that it grows together with *Nepenthes reinwardtiana* and *Nepenthes zakriana*. Current distribution record of this species is confined to its type locality of the species and on the foot of Mt. Trusmadi in Sabah, along the road in open secondary vegetation. We believed that its distribution is widespread at the same elevation in the same habitat type of highland of Sabah.

Morphological examination of the species from our specimen collections showed that it is very closely related to *Nepenthes reinwardtiana* (Table 1). However, these two species exhibit many morphological differences and therefore they cannot be united into the same species. Their morphological differences are summarized in Table 2.

***Nepenthes reinwardtiana* Miquel, junghuhnianae 168 (1852)**

Upper stems: Triangular or angular in shape with two wings extend almost the whole length of internode, 3-5 mm thick, internodes 2-4 cm long, leaves sessile, 11-15 cm long, 2-3.5 cm wide, linear to linear lanceolate, base obtuse and winged extended almost the whole length of internodes, apex acute, longitudinal nerves 2-3 on each side, tendrils 4-25 cm long. Upper pitchers:

Table 1: Morphological similarities between *Nepenthes naquiyuddinii* and *Nepenthes reinwardtiana*

Morphological characters	*Nepenthes naquiyuddinii*	*Nepenthes reinwardtiana*
Shape of upper stem	Cylindrical	Cylindrical
Inner cavity of upper and lower pitcher	Partly glandular, covered with overarched digestive glands	Partly glandular, covered with overarched digestive glands
Leaf base attachment	Decurrent	Decurrent
Lower surface of pitcher lid	Midrib extended over the whole length	Midrib extended over the whole length
Spur	Simple, cylindrical, attach on lid base	Simple, cylindrical, attach on lid base
Male inflorescence	Raceme; pedicels commonly 2-flowered, very rarely 1-flowered always towards the tip	Raceme; pedicels commonly 2-flowered, very rarely 1-flowered always towards the tip

Table 2: Morphological differences between *Nepenthes naquiyuddinii* and *Nepenthes reinwardtiana*

Morphological characters	*Nepenthes naquiyuddinii*	*Nepenthes reinwardtiana*
Two spot on inner cavity wall below peristome of upper and lower pitchers	Absent	Present
Leaves	Sessile to petiolate	Sessile
Inner peristome margin	Tooth	Entire
Shape of upper pitchers	Upper 1/3 region tubular and lower 2/3 region infundibulate	Infiundibulate on upper and lower portion and tubular on the middle portion
Shape of lower pitchers	Tubular upper 1/3 and ventricose lower 2/3 portion	Infiundibulate on upper and lower portion and tubular on the middle portion
Leaves apex of lower stem	Apical and subpletate	Apical only
Persitome rib	Distinct	Inconspicuous

Infundibulate on the upper 1/5 and widened towards mouth, tubular on middle portion and infundibulate on lower half region, 14-18 cm long, 4-5 cm wide below the peristome, 2-4 cm wide in middle portion, 3-4 cm on lower region, 2 prominent ribs running over whole length, mouth round, oblique, 3-7 cm long and 3-5 cm wide, peristome cylindrical, 1-2 mm thick, inner peristome margin entire, peristome ribs inconspicuous, inner surface of pitcher partly glandular, covered by overarched digestive glands, 2 spots distinctly present on the inner pitcher surface beneath peristome; lid orbiculate, 3-5 cm long, 3-4 cm wide, underneath entirely covered with small nectar glands, midrib faintly distinct and running up to 4/5 of the entire length but not reaching apex, spur cylindrical, simple and inserted on lid base. Female inflorescence: Raceme; peduncle 10 cm long, rhachis 12 cm long; ebracteolate, pedicels almost all 2-flowered (Fig. 1 and 2).

Specimens examined: Jumaat H. Adam, JHA 8015, Sabah, Keningau-Kimanis Road, Taman Banjaran Crocker, N05' 27.452 and E116' 02.422, 30th April 2003, Altitude: 1300 m, growing on roadside in secondary vegetation; Aminah Anting 7, Research Plot 2, Jalan Kimanis, Taman Banjaran Crocker, Alt: 1398 m, 1st September 2003.

Distribution: Borneo, Moluccas and Sumatra

Altitude: 0-1400 m.

Notes: This species have been recorded from Borneo, Moluccas and Sumatra (Adam and Wilcock, 1993). Previous researchers reported the occurrence of this species Peninsula Malaysia (Danser, 1928; Holttum, 1940; Kurata, 1976; Macfarlane, 1908; Som, 1988; Phillipps and Lamb, 1988). Its occurrence in Peninsular Malaysia is very doubtful as there is no specimen record of the species in the herbarium in Malaysia, Singapore, Bogor and Europe. The doubtful distribution of the species in Peninsular Malaysia have discussed by Adam and Wilcock (1993). Som (1988) in her treatment confessed that she had not seen specimen of it collected from Peninsular Malaysia. She convinced it existence in Penisula Malaysia based on her personal communication with George Shivas.

It can easily be identified by the present of two spots present on the inner wall cavity below the peristome of upper and lower pitcher. Other distinctive characters which is helpful to identify the species includes its stem which is triangular or angular in shape, sessile leaves and winged based, the wings are extend over the whole length of internodes, raceme of both male and female inflorescence, pedicels not extended by bract and commonly 2-flowered and 1-flowered towards the tip.

Fig. 3: *Nepenthes zakriana* (Adam and Wilcock) Adam and Hafiza showing lower pitcher

***Nepenthes zakriana* (Adam and Wilcock) Adam and Hafiza, Stat. Nov.:** *Nepenthes curtisii* sp. *zakriana* Adam and Wilcock, *The Sarawak Museum Journal*, Vol L. No. 7 (New Series), 150-151 (1996); *Nepenthes fusca* Danser in C. Clarke, Nepenthes of Borneo, Natural History Publication Borneo and Science and Technology Unit Sabah. 87-88 (1997); in Kurata, Nepenthes of Mt. Kinabalu. Sabah National Parks Publication No 2. Sabah National Parks Trustees, Kota Kinabalu, (1976); in Phillipps A and A Lamb 1988. Pitcher-plants of East Malaysia and Brunei. Nature Malaysiana, 13(4): 25 (Fig. 3 and 4).

Type specimen: Jumaat H. Adam, Julaihi H. Adam and Aliosman, JHA2431, Sabah, Kinabalu National Park, Mt. Kinabalu, Mamut, 21st January 1988 (Holotype UKMB)

Lower stem: Cylindrical, 4-5 mm thick, internodes 2-3 cm long, leaves 10-12 cm long, 2.5-4 cm wide, oblong, lanceolate and elliptic in shape, base obtuse and not winged, apex acute, apical or peltate, tendril attached 3-5 mm below leaf apex, petiole 2-4 cm long, longitudinal nerves 2-3 pairs, tendrils 25-30 cm long. Upper stem: Cylindrical, 3-5 mm thick, internodes 1.5-4.5 cm long, leaves 5-10 cm long, 2.5-4 cm wide, oblong, lanceolate and elliptic in shape, base obtuse, semi-amplexicaul and not winged, apex acute, apical, petiole 1-3 cm long, longitudinal nerves 2-3 pairs, tendrils without pitcher curled, 4-15 cm long, 25-30 cm long, tendrils with pitchers

Fig. 4: *Nepenthes zakriana* (Adam and Wilcock) Adam and Hafiza showing funnel shape upper pitcher and very narrow pitcherlid

16-25 cm long. Lower pitchers: 15-23 cm long, upper portion tubulose in shape, 3-5 cm wide, lower portion ventricose in shape, 3.5-5cm wide, anterior with 2 fringed wings running over whole length, mouth ovate, horizontal in front and greatly elevated towards the pitcher lid, 5-7 cm long and 2-4 cm wide, peristome cylindrical, 5-8 mm thick, inner peristome margin with distinct peristome teeth, peristome ribs conspicuous, inner surface of pitcher partly glandular; lid cuneate, 4-5 cm long, 1-2 cm wide, underneath covered with nectar glands, midrib greatly elevated running entire length and extending 2-3 mm over apex forming conspicuous apical glandular appendages, basal portion of midrib forming nail shape ridge known as glandular crest; spur cylindrical, 5-8 mm long, simple and inserted 2-3 mm below lid base. Upper pitchers: Infundibulate, 11-19 cm long, 4-6 cm wide below peristome, 2 prominent ribs running over whole length, mouth ovate, horizontal in front and greatly elevated towards the pitcher lid, 5-7 cm long and 3-5 cm wide, peristome cylindrical, 2-7 mm thick, inner peristome margin with distinct peristome teeth, outer peristome margin undulating, peristome ribs conspicuous, inner surface of pitcher wholly glandular; lid very narrowly cuneate, 3-5 cm long, 0.5-1 cm wide, underneath covered with nectar glands, midrib greatly elevated running entire length and extending 2-3 mm over apex forming conspicuous apical glandular appendages, basal portion of midrib forming nail shape ridge known as glandular crest; spur cylindrical, 5-12 mm long, simple and inserted 2-3 mm below lid base. Male inlorescence: Raceme; peduncle 3-8 cm long, rhachis 10-13 cm long; pedicels 2-flowered. Female inflorescence: Raceme, peduncle 10-11 cm long, rhachis 12-13 cm long, pedicels 2-flowered.

Specimens examined: Jumaat H. Adam, JHA8014, Sabah, Keningau-Kimanis Road, Taman Banjaran Crocker, N05'27.452 and E116'02.422, 30th April 2003, Altitude 1398 m; Jumaat H. Adam, JHA8017, Sabah, Keningau-Kimanis Road, Taman Banjaran Crocker, N05'27.452 and E116'02.422, 30th April 2003, Altitude 1200 m; Jumaat H. Adam, JHA8018, Sabah, Keningau-Kimanis Road, Taman Banjaran Crocker, N05'27.393 and E116'02.292, 30th April 2003, Altitude 1400 m; Aminah Anting 2, Sabah, Keningau-Kimanis Road, Taman Banjaran Crocker, N05'27.452 and E116'02.422, 13th July 2003, Altitude 1398 m; Aminah Anting 3, Plot 1, Sabah, Taman Banjaran Crocker, Keningau-Kimanis Road, Along roadside in secondary vegetation, N05'27.393 and E116'02.292, 13th July 2003, Altitude 1372 m; Aminah Anting 5, Sabah, Plot 2, Keningau-Kimanis Road, 19th August, Altitude 1424 m; Aminah Anting 6, Plot 3, Keningau-Kimanis Road, N05'.27.493 and E116'04.276, 19th August 2003, Altitude 1424 m

Distribution: Sabah (Borneo)

Altitude: 1200-1500 m.

Notes: This species have very close affinity with *Nepenthes fusca* Danser by their cylindrical shape of upper stem, upper pitchers infudibulate in shape, inner wall cavity of upper pitcher almost wholly glandular, inner wall cavity of lower pitchers partly glandular and male inflorescence raceme. *Nepenthes zakriana* (Adam and Wilcock, 1993) consistently differed from *Nepenthes fusca* by prominent raised midribs, extended beyond apex forming an apical glandular appendages on lower lid surface of both upper and lower pitchers; and basal half portion of the midrib developed in nail-shaped glandular crest. The midrib on lower lid surface of *Nepenthes fusca* extends up to basal half portion only forming glandular crest but never extend beyond apex thus not forming apical glandular appendages. According to Danser (1928) the pedicels of male inflorescence of Nepenthes fusca sometimes all of them 1-flowered sometimes partly 2-flowered. On the other hand, the pedicels of male inflorescence of *Nepenthes zakriana* are consistently commonly 2-flowered with few 1-flowered towards the tip. These differences deserved splitting of these two taxa into two different species.

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