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## Contents

**Front Cover:** A spectacular dark and pitcher of *Nepenthes leonardoi*. **Photo Greg Bourke**

**Back Cover:** A lower pitcher of *Nepenthes bicalcarata*. **Photo Richard Nunn**

<b>Title</b>	<b>Author</b>	<b>Page</b>
A New Pitcher Plant from Palawan: <i>Nepenthes leonardoi</i>	Stewart McPherson, Greg Bourke, Jehson Cervancia, Mark Jaunzems, Elizabeth Gironella, Alastair Robinson and Andreas Fleischmann	4
The <i>Nepenthes</i> of Mulu National Park	Greg Bourke	20

# UPCOMING SPEAKERS AND EVENTS

<b>Date</b>	<b>Subject</b>	<b>Speaker(s)</b>
11th March 2011	The lost world of Mount Roraima	Stewart McPherson
19th March	Plant Sale Mt Annan RBG	
8th April	The discovery of <i>Nepenthes leonardoii</i>	Greg Bourke and Stewart McPherson
16th-17th April	Rare Plant Fair Bilpin	
13th May	Trivia night	
15th May	Koi, Pet and Garden show	Fairfield Showground
10th June	The recently discovered <i>Nepenthes</i> species	Stewart McPherson
8th July	Tuberous <i>Drosera</i>	Greg Bourke
12th August	General talk	
9th September	Trip to Tasmania	Robert Gibson and Kirk Hirsch

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# *Nepenthes leonardo* (Nepenthaceae), a New Pitcher plant Species from Palawan, Philippines.

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## ABSTRACT

A distinct *Nepenthes* from the upper slopes of Schom-carp Peak (Shumkat Peak, Shumkak Peak), on Palawan Island in the Philippines, is described and illustrated. It is the only *Nepenthes* species known from the upper slopes of Schom-carp Peak, and the easterly ridge top of the mountain extending towards the coast, and towards the outskirts of the town of Narra. *Nepenthes leonardo* appears closely related to the morphologically similar species *N. deaniana* Macfarl., *N. gantungensis* S. McPherson, J. Cervancia, Chi. C. Lee, M. Jaunzems, F. Mey, A.S. Rob., and *N. mira* Jebb & Cheek, but can

be distinguished on the basis of its distinct leaf and pitcher morphology and growth habit.

**Key words:** *Nepenthes*, Philippines, Palawan, Schom-carp Peak, taxonomy, *N. leonardoii*.

#### SPECIES DESCRIPTION

***Nepenthes leonardoii*** S. McPherson, G. Bourke, J. Cervancia, M. Jaunzems, A.S. Rob. sp.nov. – Figures 1 - 12.

**Holotype** - Philippines, Palawan Island, Municipality of Narra, close to the summit of Schom-carp Peak, 1490 m, November 20, 2010. S. McPherson SRM 5 (PPC).

**Diagnosis** - *Nepenthi mirae* Jebb & Cheek similis sed caule internodiis brevioribus (18-180 mm longis), ascidiis inferioris minoris (80-150 mm), et ascidiis superioris nigris cylindricis."

Terrestrial upright to scrambling or climbing unbranched shrub, to 4 m tall. **Stem** Cylindrical, 1.5-2.8 cm in diameter, internodes 1.5-18 cm long, compact in scrambling plants and elongated in climbing stems. **Leaves:** Coriaceous, petiolate or subpetiolate, lamina narrowly oblong, 15-50 cm long and 6-10 cm wide, apex usually acute or rounded, sometimes abruptly truncated, base shortly attenu-

ate or obtuse, clasping the stem by two thirds its circumference to entirely. Tendril up to 130 cm long occasionally longer, particularly in lower pitchers, coiling in upper pitchers. Leaves of juvenile plants are commonly narrower to the base, developing a more oblong shape at submaturity. Tip of lamina occasionally meeting the tendril unequally on either side of midrib, one side up to 3 mm shorter than the other. Apex occasionally peltate, tendril emerging from the leaf up to 4 mm from the apex. **Lower Pitchers:** To 15 cm tall and 6 cm wide usually smaller, wholly ovate or urceolate, rarely globose. Wings up to 12 mm wide, with narrow filaments to 10 mm long. Pitcher opening oval or circular, up to 6 cm wide, elevated towards the lid and elongated into a prominent, narrow column. Peristome cylindrical, occasionally slightly flattened, to 2 cm wide, ribs to 2 mm high, spaced up to 2 mm apart, forming elongated teeth on the inner margin of the peristome up to 4 mm long. Inner surface glandular, usually only

in lower two thirds of pitcher, or occasionally glandular throughout. Peristome expanding below the lid and up to 2.5 cm wide. Lid elliptic, up to 5.5 cm long and 3.5 cm wide. No appendage or keel. Spur up to 9 mm long and 3 mm wide at base, occasionally much smaller. **Upper Pitchers:** Wholly infundibular to infundibular in the lower quarter and cylindrical or rarely tubular above, up to 24 cm tall, 6 cm wide, typically much smaller. Wings absent, all other parts identical to the lower pitchers. **Inflorescence:** A panicle. Male inflorescence up to 50 cm long, although usually much smaller, particularly in exposed areas, 1 cm wide at base, rachis to 30 cm long. Female inflorescence up to 45 cm long, although usually much smaller, particularly in exposed areas, 1 cm wide at base. Vestigial leaf often present on inflorescence, below flowers. Inflorescence of both sexes up to c. 120 flowers, densely arranged, rachis comprising the distal quarter to half of scape, predominantly 1-flowered pedicels, but occasionally 2-flowered pedicels or a mix of both. Exposed plants exceptionally producing rigid inflorescences to 110cm long, with flowers present along distal 15% of

inflorescence. Fruit to 8 mm long, seeds filiform, c. 7mm long, pale brown. *Nepenthes leonardoi* may flower both as a compact rosetted plant bearing only lower pitchers, or as a climbing vine. Male inflorescences have a distinctive, musty, sweet scent that is discernable up to 60 cm away. Scent of female inflorescence unknown. **Indumentum:** Consisting of simple, caducous reddish-copper hairs to 2 mm long, usually shorter, sparsely present on all sides of the tendrils, and very sparsely along the margins of the lamina, underside of the midrib, and across the exterior surfaces of the pitchers. Indumenta of leaf margin and midrib are particularly conspicuous on developing (unfurling) leaves. **Colour:** All parts of the lamina and petiole may be pure green in shade, or reddish purple in direct sunlight. In a minority of plants, the lower surface of the leaf, and/or the stem may be pure red or reddish purple. Often the red stem colouration is discernable in young plants. The colouration of the lower and upper pitchers is very variable, and includes extremes not found in any documented *Nepenthes* of the Philippines. The exterior of the lower pitchers are typically

orangey red, usually lined with faint, dark purple blotches. The peristome is bright red, usually suffusing dark reddish purple as the foliage ages, and the lid is variably yellow or orange, often with variable red suffusion. The wings may be the same colour as the exterior of the pitcher, or may be yellowish-green. The upper pitchers are mostly pure yellowish green, except for the peristome, which may be orange or red and, in some strains, faint dark red blotches may be visible on the exterior of the pitcher. Both pitcher types may often be pure burgundy at one end of a continuous spectrum, to pure yellowish green at the other end. Strains with burgundy pitchers are observed much more commonly than in all other closely associated species. Uniquely, the upper pitchers of a minority of plants may appear practically black. Flash photography reveals this dark colouration results from highly concentrated purple pigmentation and the indumentum of brown hairs, which combine to make the pitchers appear intensely dark, especially when wet.

#### **Additional material examined**

- *Nepenthes attenboroughii*: Palawan, Mount Victoria, 1650

m, 24.vi.2007, A. Robinson AR001 (holo; PPC!), AR002 (PPC!). *N. mira*: Palawan, 1580 m, 22.i.1998, G. C. G. Argent *et al.* 25438 (holo; K!). *N. mantalingajaniensis*: Palawan, Mount Mantalingahan, 1700 m, 2.iii.1992, G. C. G. Argent & E. M. Romero 92114 (K!). *N. rajah*: Borneo, Mt. Kinabalu, 1500 m, 1867, Low *s.n.* (holo; K!).

**Distribution** - Schom-carp Peak, and the easterly ridge leading towards the eastern coastal plain of Palawan, towards the outskirts of the municipality of Narra, Palawan, Philippines. The distribution of *N. leonardoii* east from Schom-carp Peak, along the connecting ridge from Schom-carp Peak to the Brow Shoulder massif, could not be established, but the occurrence of this plant on the unexplored connecting ridge, or possibly on the Brow Shoulder massif itself seems likely. The known distribution of *N. leonardoii* on Schom-carp Peak, and on the easterly ridge is 1300m to the summit of Schom-Carp Peak, which stands at 1490m.

**Ecology** - *Nepenthes leonardoii* grows mainly amongst upper montane forest above 1300 m on the eastern ridge leading to

Schom-carp Peak, and amongst upper montane scrub on the summit of the Schom-carp Peak massif. Plants growing in shade, in densely vegetated conditions, often have longer nodes, while those growing in exposed areas form compact stems, but otherwise the pitchers and inflorescences are of enlarged proportions (see *Comparison with other species*). Similar to *N. attenboroughii*, *N. deaniana*, *N. gantungensis*, *N. mantalingajanensis*, *mira*, and *N. palawanensis*, *N. leonardoi* does not compete effectively with bamboo, and as a result is rarely observed, or absent from the summit of the eastern ridge leading towards the municipality of Narra. Large numbers of living mosquito larvae were observed within the pitchers (both types) of *N. leonardoi*, and so infaunal associations and communities likely exist, but identification of the observed associated organisms was not yet possible.

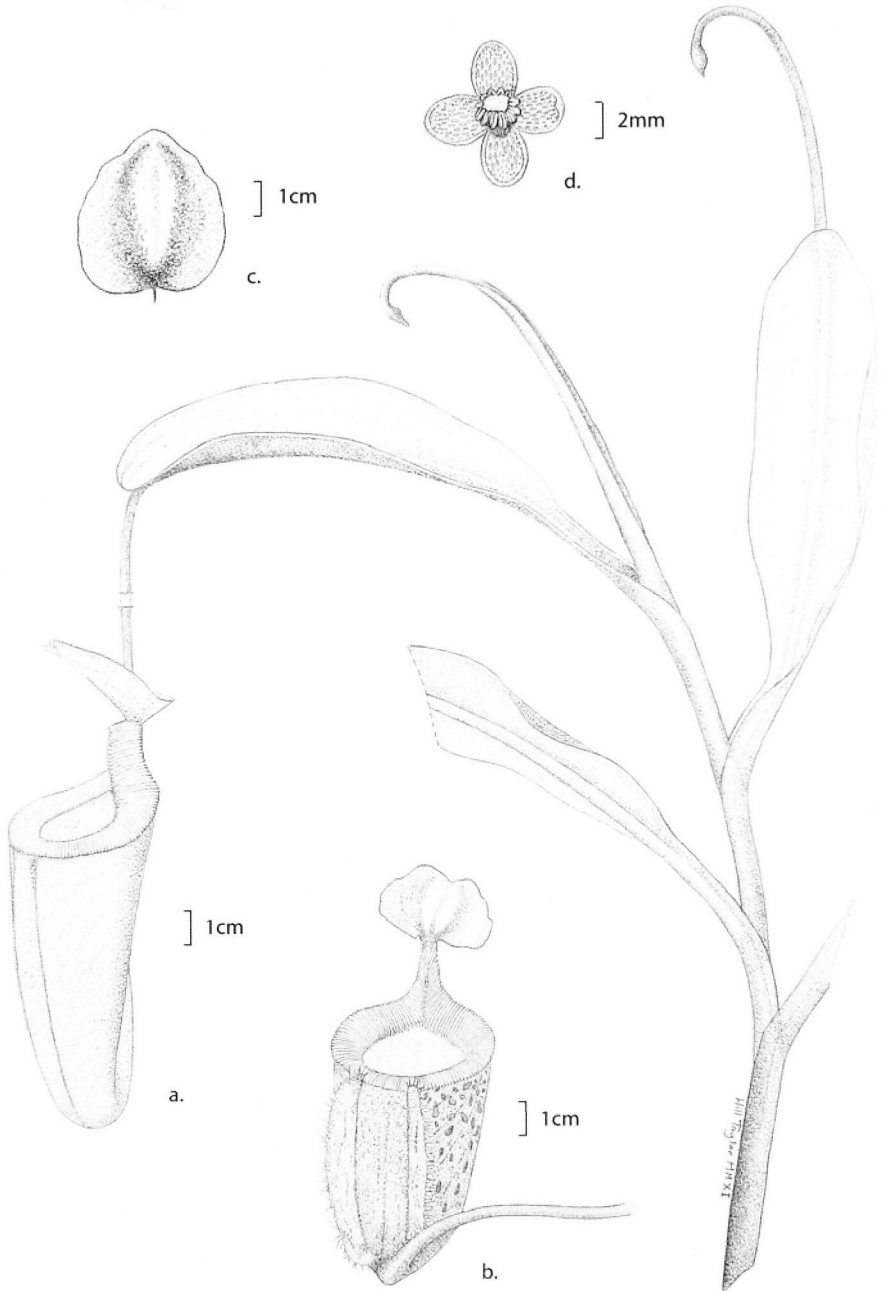
**Etymology** - The specific epithet *leonardoi* was chosen to honour Leonardo Co, a celebrated Filipino botanist who, along with members of his team, tragically was killed on November 15<sup>th</sup>, 2010 in the forests on Leyte Island. Co and his re-

searchers were surveying a forest plot of the Energy Development Corporation (EDC) for native Philippine trees and plants, and especially those that are in danger of extinction. The first four authors of this species discovered this plant on November 18<sup>th</sup>, and felt it fitting to name this plant, which is unique among Philippine *Nepenthes* in producing black pitchers, after Leonardo, in honour of his life-work and many accomplishments.

**Comparison with other species** - *Nepenthes leonardoi* shows morphological similarity to *N. gantungensis*, *N. deaniana*, *N. mira*, and collectively these four taxa represent a clear complex of extremely closely related species that evidently share a close common ancestry (McPherson, 2009: 2010). Each of these four plants is known only from single populations amidst the uppermost summit vegetation of geographically separated peaks scattered along the length of Palawan.

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**Figure 1:** *Nepenthes leonardoi* S. McPherson, G. Bourke, J. Cervancia, M. Jaunzems, A.S. Rob. . **a.** climbing stem with upper pitcher; **b.** Lower pitcher; **c.** Upper surface of lid **d.** Male flower



These four *Nepenthes* taxa display very similar leaf and pitcher morphology, long tendrils and comparable ecology, but differ subtly in their inflorescence structure and size, pitcher morphology and colouration. In sub-optimal conditions (i.e. marginal habitat, and particularly shady upper montane forest), these four species may appear almost indistinguishable, defaulting to producing very similar, etiolated pitchers and foliage in shady, densely vegetated areas. However, where they are observed growing in typical habitat (particularly in exposed areas subject to strong insolation), the differences between each of these species are expressed clearly, and each is identified through several distinct characteristics.

*Nepenthes leonardoii* bears a most profound similarity to *N. deaniana* and *N. mira*, and may be distinguished from these taxa by its upper pitchers, which are often partly cylindrical, uniquely coloured (for example, black), and are produced in abundance. *Nepenthes deaniana* and *N. mira* both produce relatively few upper pitchers (S. McPherson pers. obs., vs. Jebb & Cheek), and primarily only as large,

climbing vines, and the overall size of the upper traps is smaller in *N. leonardoii* overall. Also, while the leaves of *N. leonardoii* may be abruptly truncated, those of *N. deaniana* and *N. mira* are not known to be. Additionally, while the lower pitchers of *N. deaniana* and *N. mira* may reach very large sizes, those of *N. leonardoii* are generally comparatively small. Further minor differences may be identified through comparison of lower trap morphology and indumenta, leaves and inflorescences (see Table 1).

*Nepenthes gantungensis* produces upper pitchers that are very similar and equally variable to those of *N. leonardoii*, and the morphology of the traps cannot be reliably used to distinguish these taxa. While *N. leonardoii*

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**Opposite page clockwise from top - Figure 2:**

The foliage of a *N. leonardoii* plant growing in shade in upper montane forest. **Figure 3:** An upper pitcher exhibiting mottled red colouration rarely seen in *N. deaniana*, *N. gantungensis* or *N. mira*. **Figure 4:** A greenish yellow upper pitcher of *N. leonardoii*

**Pages 12 & 13 - Figure 5:** Based on observations presented in McPherson (2009; 2010) and collected during field work preceding this work



	<i>N. attenboroughii</i>	<i>N. deaniana</i>	<i>N. gantungensis</i>
<b>Lower pitchers</b>	wholly campanulate, often flaring widely towards the opening, up to 30 cm tall and 16 cm wide.	ovate, globose, amphora shaped, urceolate or almost cylindrical. 30 cm tall and 20 cm wide, often pure red or purple.	wholly ovate or urceolate, up to 20 cm tall and 7 cm wide. never pure red or purple.
<b>Upper pitchers</b>	wholly infundibular and up to 25 cm tall and 12 cm wide.	uncommon, wholly infundibular, up to 35 cm tall and 16 cm wide.	very common, wholly infundibular or partly cylindrical, up to 25 cm tall and 7 cm wide.
<b>Leaf</b>	40 cm long, 15 cm wide, apex obtuse or occasionally retuse, not peltate, base shortly attenuate, sessile or sub-petiolate, amplexicaul.	40 cm long, 18 cm wide, apex rounded or obtuse, base abruptly contracted into a canalicate petiole that clasps the stem. apex occasionally sub petiolate.	40 cm long, 12 cm wide, apex acute or rounded, base shortly attenuate or obtuse, clasping the stem by two to three thirds of its circumference.
<b>Inflorescence</b>	up to 80 cm long, consisting entirely of 1-flowered pedicels.	up to 40 cm long, consisting mainly of 2-flowered pedicels, basal pedicels with adjacent bracts.	up to 60 cm long, often consisting entirely of 1-flowered pedicels, less commonly 1- and 2-flowered.
<b>Stem</b>	up to 1.5 m long. compact, not known to climb.	up to 6 m long. commonly scrambling or climbing.	up to 3.5 m long. commonly scrambling or climbing.
<b>Indumentum</b>	long, prominent reddish hairs on the lamina margin in adult plants.	tendrils, pitchers and the upper side of the lid are lined with short, reddish-brown hairs. the stem, inflorescence and upper surface of the leaves are generally glabrous.	underside of tendrils, consisting of simple, densely arranged, caducous reddish-copper hairs to 3 mm long. hairs up to 2 mm in length scattered over young pitchers, and on the margins of the lamina. hairs turning silver as they age
<b>Habitat</b>	exposed, open areas of low growing upper montane scrub. not known from forest or shaded habitat.	upper mountain forest, often in shade and in open scrub on ridge top and summit areas.	upper mountain forest, often in shade, and open scrub in ridge top and summit areas.

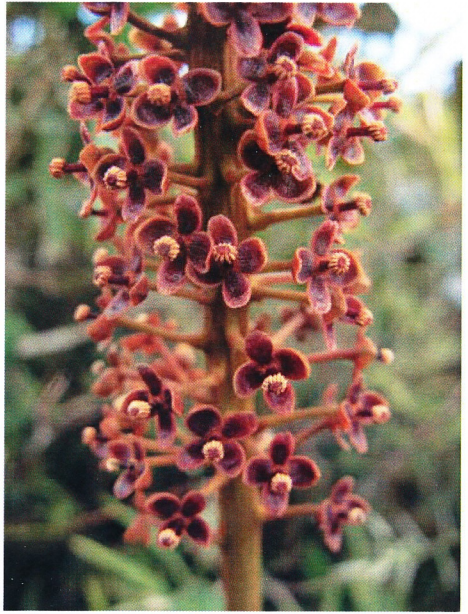
<i>N. leonardoii</i>	<i>N. mantalingajanensis</i>	<i>N. mira</i>	<i>N. palawanensis</i>
wholly ovate or urceolate, or rarely globose. up to 15 cm tall and 6 cm. occasionally pure red or purple.	generally ovate or amphora shaped, up to 15 cm tall and 6.5 cm wide. Usually yellow with a dark red or purple peristome.	wholly ovate, ellipsoid or urceolate, up to 24 cm tall and 15 cm wide. rarely pure red or purple.	broadly cylindrical in the upper parts, infundibular below. up to 34 cm tall and 14 cm wide
very common, wholly infundibular to infundibular in the lower quarter and cylindrical, occasionally tubular above, up to 24 cm tall, 6 cm wide, typically much smaller. upper pitchers more cylindrical than in any other palaweño <i>nepenthes</i> documented.	not known to be produced.	uncommon, wholly infundibular, up to 22 cm tall and 9 cm wide.	not known to be produced.
to 50 cm long, 10 cm wide, apex usually acute or rounded, sometimes abruptly truncated, base shortly attenuate or obtuse, clasping the stem by two thirds its circumference to entirely .	to 20 cm long, 6 cm wide, apex acute or obtuse, rarely sub-peltate, base attenuate, sub-petiolate to petiolate, and amplexicaul. Often petiolate. Petiole broad, to 7 cm long, and canaliculated	to 50 cm long, 15 cm wide, apex rounded, base abruptly contracted and petiolate. petiole up to 6 cm long and canaliculate.	to 45 cm long, 15 cm wide, apex obtuse or occasionally retuse, not peltate, base shortly attenuate, sessile or sub-petiolate, amplexicaul
up to 50 cm long, consisting of 1-flowered pedicels, occasionally 2-flowered pedicels or a mix of both.	Up to 35 cm long, consisting of 1-flowered pedicels.	up to 60 cm long, consisting of both 1- and 2-flowered pedicels.	up to 115 cm long. pedicels 1-flowered, rarely 2-flowered at base. male inflorescence with, ciliate, decurrent bract-like outgrowths on the rachis.
up to 4 m long. commonly scrambling or climbing.	rigid, upright stem 30-60 cm tall. not known to climb.	up to 10 m long. commonly scrambling or climbing.	up to 1 m long. Compact. not known to climb.
simple, caducous reddish-copper hairs to 2 mm long, sparsely present on all sides of the tendrils, and usually very sparsely along the margin so of the lamina, and variably across the exterior surfaces of the pitchers.	leaves, tendrils and pitchers are predominantly glabrous, although brown, velveteen hairs may cover the spur.	tendrils, lower surface of the midrib, pitchers and parts of the inflorescence are covered with short, soft, reddish or golden hairs. other parts glabrous	margin of the lamina lined with short, silvery hairs or no hairs at all.
growing in upper mountain forest, often in shade, as well as in open scrub in ridge top and summit areas.	exposed, areas and low growing upper montane scrub. not known from forest or shaded habitat.	upper mountain forest, in shade, or open scrub on ridges and summit areas.	areas of low growing upper montane scrub. not known from forest or shaded habitat.



**Figure 6:** Upper pitchers of a climbing plant of *N. Leonardoii* on the upper slopes of Schom-carp peak



**Figure 7:** Lower pitchers of *N. leonardoi* exhibiting typical pitcher morphology and colouration for specimens growing in optimal conditions



does uniquely produce upper pitchers in abundance, this characteristic cannot be reliably used for diagnosis and since the majority of *N. leonardoii* plants produce upper traps that are predominantly yellow, green or reddish – colouration that is also seen in *N. gantungensis*, although pure reddish upper pitcher are not as common. Tangible differences include the structure of the leaves of *N. leonardoii*, which have a more pronounced, narrower petiole, and also the inflorescences, which are generally shorter in overall stature. The distinctive musty scent of *N. leonardoii* is also unknown from *N. gantungensis*, and the former is ecologically better adapted to growing in upper montane forest climbing, vigorously on a typically longer stems.

*Nepenthes mantalingajanensis* bears fewer similarities to *N. leonardoii* and the associated complex, although it is easily distinguished by its divergent

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**Opposite page clockwise from top left - Figure 8:** A male inflorescence of *N. leonardoii*. **Figure 9:** Macro photograph of male inflorescence of *N. leonardoii*. **Figure 10:** Close up of peristome structure of the lower pitchers of *N. leonardoii*

leaf shape and size, and very compact overall stature.

*Nepenthes leonardoii* is more distantly related to *N. attenboroughii* and *N. palawanensis*, two of the largest of all *Nepenthes* which are found on the summits of Mount Victoria and Sultan Peak respectively. Although the overall pitcher and leaf morphology of these plants bears similarities to *N. leonardoii*, these plants are unlikely to be confused for this taxon on account of their considerably larger size, compact overall growing habit, and distinctive, broad spurs. Furthermore, *N. palawanensis* is known only to produce lower pitchers (even when mature and flowering), whereas *N. leonardoii* produces them abundantly.

Slightly aberrant plants were observed in populations of *N. leonardoii* growing on the uppermost slopes of Schom-carp Peak. These plants grew more compact, and bore shorter foliage, larger pitchers, and larger, rigid inflorescences. Whilst conceivably within the natural variability of *N. leonardoii* as a whole, it might also be possible that these plants growing in open scrub might have received. That *N. leonardoii* commonly

produce flowers as in the compact, basal rosette stage, and not just as a climbing vine, also supports this theory, although *N. deaniana*, *N. gantungensis*, *N. mantalingajansensis* and *N. mira* may all occasionally flower when growing in this manner (McPherson, 2009).

Since no other *Nepenthes* species occur at high altitudes on the upper slopes of Schom-carp Peak, *N. leonardoi* may easily be recognised in the wild without risk of confusion.

**Conservation status** - *Nepenthes leonardoi* is assessed here as CR (critically endangered) according to the World Conservation Union Red List Criteria B2a (IUCN 2001): it is known only from the summit area of a single mountain system in a very restricted habitat range and the known number of individual plants is limited to a few thousand individuals. The summit of Schom-carp Peak currently remains pristine and is seldom visited, although mining activities on the nearby Mount Victoria Massif to the south may represent a threat to the wildlife of Schom-carp Peak, particularly if much needed protective legislature protecting Mount Victoria is

not enforced.

## ACKNOWLEDGEMENTS

The authors would like to extend their gratitude towards the Philippine Council for Sustainable Development (PCSD), The Department of Environment and Natural Resources (DENR), and environmental Local Government Units (LGU) for the completion of this study. We also thank the staff of Palawan State University Herbarium for kindly providing access to study the type specimens and to William Taylor for the beautiful botanical illustration.

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**Figures 11 (opposite left) and 12 (opposite right):** *N. Leonardoi*, exhibiting distinctive colouration that superficially appears almost black (above left), although a photograph of the same pitcher by flash (above right) reveals it is actually due to concentrated dark purple colouration



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Robinson, A.S., Fleischmann, A.s.

# The *Nepenthes* of Mulu National Park

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Mulu National park is the only World Heritage listed National Park in the state of Sarawak, Malaysian Borneo. It is situated in the central north of the state near the Brunei border. The park is most famous for its cave systems, its bats, and its spectacular limestone Pinnacles (**Figure 1**) but the park is also home to 13 of Sarawak's 25

currently recognised *Nepenthes* species.

The park covers an area of 544 sq km (Briggs, 1997) with an altitudinal range of over 2300m. Gunung (the local word for mountain) Mulu is the highest peak at 2376m asl. This peak is made of primarily sedimentary rock and is home to 5 species



**Figure 1:** The spectacular limestone Pinnacles of Mulu National Park



**Figure 2:** Tadpoles of *Microphylla nepenthicola* in *N. ampullaria*

(*N. hurrelliana*, *N. lowii*, *N. mu-luensis*, *N. tentaculata* and *N. vogelii*) while the second highest peak in the park G. Api is limestone and home to 7 species (*N. campanulata*, *N. faizaliana*, *N. hurrelliana*, *N. lowii*, *N. muluensis*, *N. tentaculata*, *N. veitchii* and *N. vogelii*). *N. campanulata* and *N. faizaliana* are limestone endemics. *N. hurrelliana*, *N. veitchii*, and *N. Vogelii* are mostly found growing as epiphytes. The remaining species *N. ampullaria*, *N. bicalcarata* and *N. rafflesiana* var. *elongata*

can be found primarily in the peat swamp forests within the park boundaries.

Here I discuss only the species I have observed within the park boundaries. It is likely other species such as *N. hirsuta* and *N. reinwardtiana* exist here.

***Nepenthes ampullaria***

*Nepenthes ampullaria* is a wide-spread species found primarily in peat swamp forest. It is unusual in that it forms large basal rosettes of pitchers on the ground with lids held back from the pitcher mouth. This allows the plant to catch anything that falls from above including leaf litter and rain.



**Figure 3:** A beautiful red pitched form of *N. ampullaria* near Camp 5. Photo Richard Nunn



**Figure 4:** A mottled form of *N. ampullaria* with a red peristome. Photo Richard Nunn

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The food webs surrounding *N. ampullaria* are many and complex but no association is more interesting than that with a small recently described frog called *Microphylla nepenthicola* (Das & Haas, 2010)(**Figure 2**). I saw and photographed the tadpoles of this species in 2001 but unfortunately didn't see any frogs.

Occasionally nice red pitched forms are found in Mulu N.P.

(**Figure 3**) but typically they are green with some purple mottling with a green or red peristome (**Figure 4**)

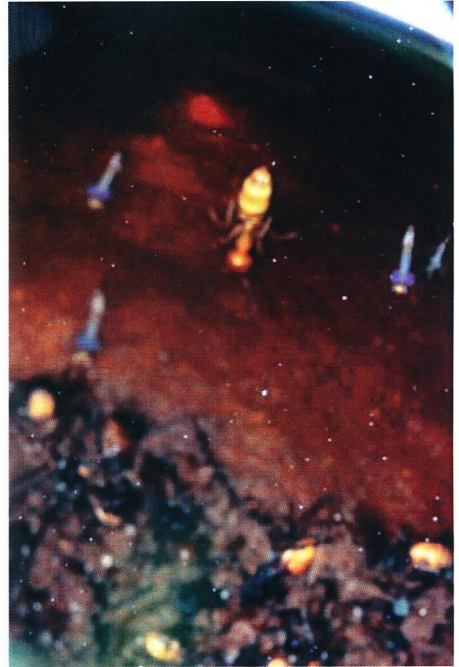
### ***Nepenthes bicalcarata***

I first saw *N. bicalcarata* (**Figure 5**) in Mulu N.P. in 2001 growing in a small area of peat swamp forest near Camp 5 and was amazed at the size of the plants. One of the largest plants in the genus with rosettes to 2m it is a spectacular sight. The pitchers are also quite spectacular having extended downward pointing spines at the upper part of the peristome commonly re-

ferred to as fangs (**back cover**). It was once thought that these fangs were to stop monkeys from stealing prey from the pitchers which is certainly not the case. The fangs are actually large nectar glands and in the right conditions, the nectar produced by the plants to attract prey flows down these fangs. Being on the tips, the nectar is both more exposed to air movement and thus more likely to attract prey and is positioned directly above the centre of the mouth of the pitcher coaxing



**Figure 5:** An upper pitcher of *N. bicalcarata*



**Figure 6:** The amazing ant (*Camponotus schmitzii*) making its way to the bottom of a lower pitcher of *N. bicalcarata* in search of prey. Note the large number of ants of another species in the bottom of the pitcher and live mosquito larvae

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prey into a more precarious feeding position.

Another unique adaptation of this species is the hollow swollen tendril coil of the pitchers which is the perfect home for an ant species (*Camponotus schmitzii*) which cuts a small entry hole into the tendril to gain access. The ants are able to



**Figure 7:** A large colony of *Nepenthes campanulata* growing in a cliff face almost 100m above the forest floor

access the pitchers swimming around in the fluid (**Figure 6**) feeding on both live and dead prey. This appears to be a fairly one sided relationship on the ants part but the ants may assist the plant's pitchers digestion process by breaking down large prey items.

### **Nepenthes campanulata**

*Nepenthes campanulata* is a delightful little species that forms only one type of pitcher. It was thought to be extinct due to habitat loss at the type location in Kalimantan until it was located for the first time in Sarawak by Ch'ien C. Lee in 1997 (Clarke & Lee, 2004). The discovery of this species in Mulu N.P. significantly extended the range of the species giving hope that it may occur in other limestone areas like those found in the Bau area. Unfortunately it has not yet been found there.

It occurs exclusively on limestone cliffs often high above the forest floor and forms dense clumps (**Figure 7**) of rosettes. It does not form vines at all as these would be useless in these habitats.

It is difficult to see *N. campanulata* in Mulu N.P. but with a good

set of binoculars or a long zoom camera lens it can be spotted on some of the vertical cliffs throughout the park.

### **Nepenthes faizaliana**

*Nepenthes faizaliana* is a beautiful species found only in the Mulu area. It has stunning dark cylindrical pitchers (**Figure 8**). It can be found growing in soil deposits on limestone or as an epiphyte usually above 1000m elevation.

*Nepenthes faizaliana* can be



**Figure 8:** The beautifully coloured *N. faizaliana*

seen growing along the trail to the Pinnacles above the long ladder. This is a strenuous day climb but well worth the effort as it is virtually impossible to see this plant elsewhere in the wild.

### **Nepenthes fusca**

*Nepenthes fusca* (Figure 9) is a variable species found primarily as an epiphyte but commonly colonises disturbed areas like land slips, roadside cuttings and areas that have been logged. It is difficult to observe in Mulu



**Figure 9:** An arial pitcher of *N. fusca* growing several metres above the ground.



**Figure 10:** A lower pitcher of *N. hurrelliana*

N.P. I have only seen plants 10m above the ground growing on the branches of trees between camp 1 and camp 2 of the summit climb of G. Mulu. The colouration of the Mulu plants is rather unusual being solid yellowish green to pink to rusty orange. I have seen similarly coloured plants in the Bario area but these were uncommon.

### **Nepenthes hurrelliana**

Once thought to represent a

hybrid between *N. fusca* and *N. veitchii*, *N. hurrelliana* (**Figure 10**) is one of the most spectacularly coloured species in Borneo. The best plants are in the Bario area and in the Meligan range on the border between Sabah and Sarawak.

On the slopes of Mt Mulu it grows as an epiphyte on moss covered trees above 1300m where plants are relatively small with pitchers to 20cm. It has a large flared peristome which is colourfully striped. Internodes extend to as much as 10cm as plants climb into the canopy.



**Figure 11:** A young plant of *N. lowii* growing epiphytically in the mossy forest

### **Nepenthes lowii**

One of the most unusual and spectacular of Mulu's *Nepenthes*, *N. lowii* (**Figure 11**) is a spectacular sight on G. Mulu. This species has been commonly referred to as the toilet bowl pitcher plant for many years and in 2009 it was proven to have an association with a small marsupial called a tree shrew that feeds on the crystalline substance produced under the lid of the pitcher (Clarke et al, 2009). Once the shrew has had its feed it drops its scat into the mouth of the pitcher. This is an easily digested fertiliser for the plant.

Although *N. lowii* occurs on G. Api (C. C. Lee pers. comm.) it is only possible to see it on G. Mulu where it occurs near to but not on the summit.

### **Nepenthes muluensis**

Although *N. muluensis* produces small pitchers it produces one of the most spectacular displays I have seen (**Figure 12**). It occurs on G. Mulu above 1900m as well as two mountains outside Mulu N.P. It is closely related to and often confused with *N. tentaculata*.

The lower pitchers of *N. muluensis* are very dark with occasionally yellow spots and can have yellow stripes on the peristome (**Figure 13**). The upper pitchers are white with blotches of dark purple or the opposite or sometimes completely white. The upper pitchers have a striking white lid which seems to almost glow.

***Nepenthes rafflesiana* var. *elongata***

*N. rafflesiana* is a variable and widespread species. There are several distinct forms that require taxonomic review but one that has been divided out is the variety with elongated pitchers.

This variety is found near the coast of Sarawak at Miri northwards into Brunei and eastwards into Mulu N.P.

The lower pitchers are smaller than other forms but certainly elongated but the upper pitchers are truly spectacular often reaching a length of over 30cm (**Figure 14**). They can be seen at several lowland sites around Mulu N.P. and grow quite close to the headquarters.

Interestingly *N. rafflesiana* var. *elongata* has recently been found to have an association with a small species of bat (*Kervivoula hardwickii* hard-



**Figure 12:** Hundreds of pitchers poke out above the summit vegetation on G. Mulu

*wickii*). The bats roost inside the pitchers and deposit their scats within (Grafe et al, 2011).

### **Nepenthes stenophylla**

Despite being widespread in the highlands of Kalimantan, Sabah and Sarawak, *N. stenophylla* (**Figure 15**) is quite rare in Mulu N.P. There are a few plants on the trail to the Pinnacles and it is likely to occur on both G. Api and G. Mulu.

The pitchers of *N. stenophylla* are yellowish green with purple blotches. In its preferred habitat *N. stenophylla* forms large bushy plants whose climbing stems often cover surrounding vegetation. I have not seen plants like this in Mulu N.P.

### **Nepenthes tentaculata**

Another widespread species occurring in both Borneo and Sulawesi *N. tentaculata* (**Figure 16**) is common on most of Borneo's mountains above 1000m although it can grow as low as 700m. The small pitchers have distinctive tentacles on the upper surface of the lid. These are also present in *N. muluensis* but the latter is usually easily distinguished by its colour and its upper pitchers which lack wings.



**Figure 14:** A large upper pitcher of *N. rafflesiana* var. *elongata*

*Nepenthes tentaculata* is easily seen on the upper reaches of the trail up to the Pinnacles as well as on the G. Mulu summit trail.

***Nepenthes veitchii***

Another widespread and variable species, *N. veitchii* is one of a few species that can occur in both lowland and highland habitats. There are several forms that possibly require dividing out at the variety level.



**Figure 15:** The colourful upper pitcher of *N. stenophylla*



**Figure 16:** A lower pitcher of *N. tentaculata*

In Mulu N.P. *N. veitchii* grows almost exclusively as an epiphyte often many metres above the ground. The pitchers on those growing on the Pinnacles trail are some of the largest for the species reaching over 20cm and gold in colouration.

***Nepenthes vogelii***

*Nepenthes vogelii* is the most recently described species that occurs in Mulu N.P. It remained unnoticed for so long as it generally occurs high in trees where it is difficult to observe. Since its discovery several sites have

been found where it occurs as a terrestrial. This is mainly due to logging activity between Mulu N.P. and the Sabah and Kalimantan borders.

In Mulu N.P. *N. vogelii* can be found growing epiphytically on both G. Mulu summit trail and the trail to the Pinnacles. The pitchers of the plants on the Pinnacles trail are particularly beautiful with their wine glass shape and distinctive colouration.

Mulu N.P. is a spectacular park and well deserving of its heritage listing. It provides a wide variety of habitats for *Nepen-*

*thes*. If you ever plan to visit south east Asia in search of *Nepenthes* Mulu N.P. is one stop that is essential.

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