

***Nepenthes* species along the trail to the summit of Mount Trus Madi, Tambunan**

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Abstract. A survey of *Nepenthes* spp. along the trail of Mt. Trus Madi in Tambunan district of Sabah, Malaysia was conducted on 28-30 March 2011 from the Starting Point (1,500 m asl) to the Yayasan Sabah Repeater (2,620 m asl). The total distance was about 4,500 m. There were three species of *Nepenthes* found along the trail from the Starting Point to the Yayasan Sabah Repeater on Mt. Trus Madi, namely *Nepenthes tentaculata*, *N. lowii* and *N. macrophylla*. Two populations of the natural hybrid *N. x trusmadiensis* were found at 2,350 m asl. Various forms of *N. tentaculata* were found along the trail to the Yayasan Sabah Repeater.

Keywords: Borneo, Mt. Trus Madi, *Nepenthes*, Sabah

INTRODUCTION

Pitcher plants that are predominantly found in the tropical rain forests in Sabah belong to the genus *Nepenthes* (Family: Nepenthaceae). Pitcher plants are climbers or scramblers. The geographic range of the genus is restricted to but scattered throughout the tropics, with the centre of distribution in Borneo, Sumatra, Peninsular Malaysia, Philippines and New Guinea. Its distribution extends eastwards to New Caledonia and Isles of Pines, westwards to the Seychelles and Madagascar, southwards to the York Peninsula, and northwards to an isolated location on Khasia Hill in India, Indo-China. However, the genus is absent from Burma.

Nepenthes spp. grow from sea level (even within the spray zone of the sea) to about 3,400 m. The species can be arbitrarily divided into two groups, viz. the lowland group and the highland group. The latter group grows commonly on high mountains at elevations above 1,000 m but occasionally extending down to about 500 m. Generally, the lowland species grow in open habitats such as secondary bushes associated with *Gleichenia* ferns, road side embankments, forest edges, swampy areas, heath forest, peat swamp forest and gaps in lowland dipterocarp forest.

The highland species are common and most conspicuous in montane rain forest. They are rare in submontane rain forest or oak forest, but some species such as *N. tentaculata* grow within the gap or in open areas of the forest. The highland species usually grow between 800 and 2,700 m.

In previous studies of *Nepenthes* on Mt. Trus Madi, it was reported that there were several species found namely, *N. naquiyuddinii* (Adam & Hafiza 2006), *N. stenophylla*, *N. tentaculata*, *N. lowii*, *N. macrophylla* and *N. x trusmadiensis* (Marabini 1984, Briggs 1984, Kulip 2006).

The objectives of this study are to list out all *Nepenthes* spp. found along the trail to the summit of Mt. Trus Madi, as well as to describe their respective distributions along the trail.

MATERIALS & METHODS

Locality of study

The study was conducted on Mt. Trus Madi (Figure 1). The name Trus Madi comes from the Dusunic word “Mongintorus,” meaning a place where one finds food in the jungle, and from Mr Semadi, who first climbed the mountain (J.P. Indu, pers. comm.).

This mountain lies in the district of Tambunan in the state of Sabah. At 2,642 m, Mt. Trus Madi is the second highest mountain in Malaysia with an estimated area of 220 ha. It is located in the western part of Sabah (5°35'N, 116°30'E). The mountain is at the centre of the Trus Madi Forest Reserve (175,877 ha) which was reclassified recently as a Class I Forest Reserve, or Protection Forest.

The mountain supports a wide range of unique flora and fauna, perhaps most notably the endemic species *Nepenthes macrophylla* and its natural hybrid *N. x trusmadiensis*. The vegetation on Mt. Trus Madi can be divided into three zones, namely Lower Montane Forest (1,500-1,850/2,000 m), Upper Montane Forest (1,850/2,000-2,500 m) and Summit Scrub (2,500-2,642 m) (Kitayama *et al.* 1993). The lower and upper montane forests on Trus Madi are very similar to those on Mt. Kinabalu, both in species composition and appearance.

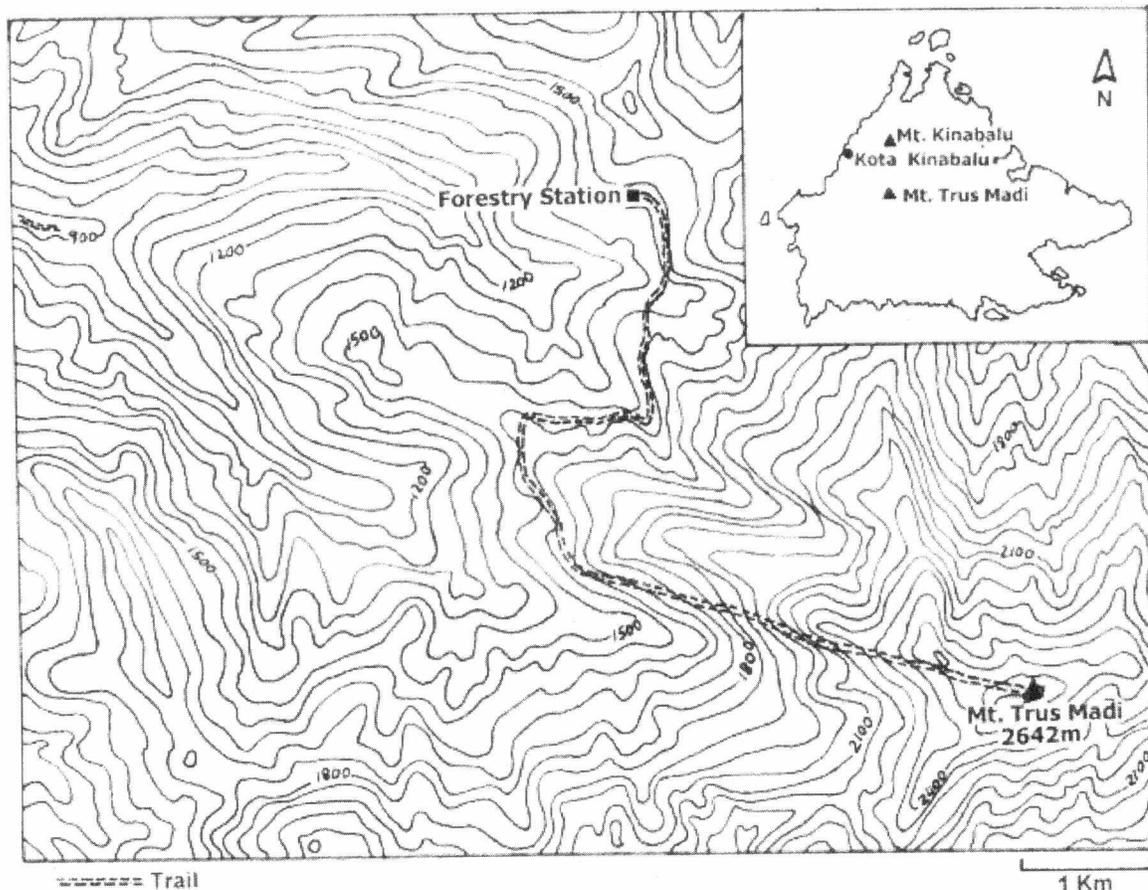


Figure 1. Map showing survey trail to the summit of Mt. Trus Madi.

Methodology

Nepenthes spp. were observed and identified on 28-30 March 2011 along the trail to the summit of Mt. Trus Madi, from the beginning of the trail (Starting Point) until the Yayasan Sabah Repeater, 400 m before the official summit of Trus Madi. We could not survey the summit area as it was closed by officials due to a helicopter accident which happened two days prior to our survey.

Species were marked as “present” in a 100 m interval along the trail if they were observed in that interval. In this survey, we gave distances in terms of how many metres had passed since the trailhead. Thus, a plant found 500 m along the trail would be near the sign reading “4,400 m to the top.” Equivalently, a check mark next to “500 m” means the plant was found somewhere between 500 m and 600 m along the trail.

Herbarium specimens for *N. tentaculata*, *N. lowii*, *N. x trusmadiensis*, and *N. macrophylla* were collected with duplicates sent to the Sandakan Forestry Department and deposited in the UMS Borneensis Herbarium.

RESULTS

Following is the list of *Nepenthes* spp. collected in the survey:

Nepenthes tentaculata

Voucher specimen No.: JK01

Collector: Kulip, J. and Butler, E.D.

Date: 29.03.2011

Locality: Along the trail at 500 m distance

Altitude: 1,635 m above sea level

GPS Location: 5°34'8.3"N, 116°29'6.6"E

Habit: Climbing in trees and scrambling on the ground. Pitcher size up to 12 cm tall

Note: See Appendix 1 for photographs

Nepenthes lowii

Voucher specimen No.: JK02

Collector: Kulip, J. and Butler, E.D.

Date: 29.03.2011

Locality: Along the trail at 2,200 m distance, near Gombunan Hut

Altitude: 2,150 m above sea level

GPS Location: 5°33'25.9"N, 116°30'9.1"E

Habit: Climbing in trees. Pitcher size up to 18 cm tall

Note: See Appendix 1 for photograph

Nepenthes macrophylla

Voucher specimen No.: JK03

Collector: Kulip, J. and Butler, E.D.

Date: 30.03.2011

Locality: Along the trail at 3,500 m distance, just above Gibon's Cabin

Altitude: 2,410 m above sea level

GPS Location: 5°33'21.1"N, 116°30'23.6"E

Habit: Climbing in trees. Pitcher size up to 30 cm tall

Note: See Appendix 1 for photograph

Nepenthes x trusmadiensis

Voucher specimen No.: JK04

Collector: Kulip, J. and Butler, E.D.

Date: 30.03.2011

Locality: Along the trail at 3,400 m distance

Altitude: 2,350 m above sea level

GPS Location: 5°33'21.1"N, 116°30'23"E

Habit: Climbing in trees. Pitcher size up to 18 cm tall

Note: See Appendix 1 for photograph

DISCUSSION

Nepenthes tentaculata

This species was present throughout most of the trail, from an elevation of 1,635 m (500 m along the trail; 5°34'8.3"N, 116°29'6.6"E) to an elevation of 2,620 m in the area of the Yayasan Sabah Repeater (4,500 m along the trail). Gaps in this range occurred at 1,000-1,100 m; 2,900-3,000 m; 3,200-3,300 m; 3,800-4,100 m and 4,300-4,400 m along the trail. These gaps may be due to lack of light or other environmental factors such as soil composition.

A great variety of morphological and colour forms of *N. tentaculata* could be found along the trail (Table 1). At 1,200-1,500 m, the pitchers became fewer in number, but along the ridge at 1,700-1,800 m, average pitcher size increased, with some over 12 cm tall (very large for this species).

Both scrambling and climbing forms of *N. tentaculata* could be found along the trail. Pitcher colours ranged from light green, to green, to pink, to red, to dark red/brown. Pink or red spots could be present or absent on pitchers. Lips of the pitchers ranged from green, to pink, to red, to dark red/brown, to grey. One form found 1,800 m along the trail had dark red leaves in addition to red pitchers. Please see Table 1 below for a detailed list of colour forms observed.

It is also notable that frog eggs were observed in the pitchers of *N. tentaculata* plants growing low to the ground at about 2,500 m asl. As no adult frogs were observed, and there is no survey of anurans on Mt. Trus Madi higher than 1,500 m asl, it is difficult to guess the frog species.

Personal communication with Mr Kueh Boon-Hee as well as Kueh (2004) suggest that the frogs may belong to the genus *Philautus* (bush frogs) or *Pelophryne* (dwarf toads). These genera are known to exist as high as 3,000 m asl, so it is possible that they might be found at 2,500 m asl on Mt. Trus Madi. In addition, *Philautus bunitus* is found at lower altitudes on the mountain, so this or a related species that also lives at higher altitudes may be responsible for the eggs. Furthermore, *Philautus* and *Pelophryne* tadpoles are non-feeding and subsist entirely on yolk, making it possible for them to survive in any water source, including the standing water in *Nepenthes* pitchers (Kueh, pers. comm.). Frogs at high altitudes may lay eggs in pitcher plants because there are few other natural water sources available (Kueh, pers. comm.).

While there are no official reports of frogs laying eggs in *N. tentaculata* pitchers, the phenomenon of frogs laying eggs in *Nepenthes* pitchers has been formally documented in other *Nepenthes* species. For example, in Sarawak, *Microhyla nepenthicola* frogs lay eggs in *N. ampullaria* pitchers (Das & Haas 2010). *Duttaphrynus melanostictus* (common Sunda toad), *Kalophrynus pleurostigma* (rufous-sided sticky frog), and *Microhyla borneensis* (Bornean narrow-mouthed frog) have also been reported to make use of standing bodies of water created by plant organs (Haas & Das 2011). However, *D. melanostictus* is found only in Sarawak and Kalimantan, and the remaining two species are found only in the lowlands, so these species are most likely not responsible for the eggs in the *N. tentaculata* pitchers. Further studies of high-altitude anurans and their relationship with *N. tentaculata* on Mt. Trus Madi should be undertaken to determine the exact nature of the interactions between frogs and *Nepenthes* in the area.

Table 1. List of *N. tentaculata* colour combinations.

Combination No.	Pitcher	Lip
1	Pink/red with darker red spots	Red
2	Light yellow green with red spots	Green
3	Red with faint spots	Green
4	Pink with no spots	Pink
5	Light yellow green with no spots	Yellow green
6	Red (and leaves)	Red
7	Green (with faint red colouring around wings)	Faint red
8	Green (and lid)	Green
9	Light green, no spots	Dark red
10	Red	Greyish red
11	Pink with red spots	Green

Nepenthes lowii

We observed one individual 2,200 m along the trail (elevation: 2,150 m; 5°33'25.9"N, 116°30'9.1"E). Aside from this individual, *N. lowii* was found only from 2,600-2,900 m along the trail, and from 3,000-4,000 m along the trail. It should be noted that the distance between the first small population and the other populations of *N. lowii* on the mountain was large. In comparison, on Mt. Kinabalu, *N. lowii* grows between 1,970-2,270 m asl (Phillipps & Lamb 1996). Therefore, the populations of *N. lowii* found along the trail generally grow at a higher altitude than those on Mt. Kinabalu. In most cases, the plants were climbing in the trees alongside the trail, with large pitchers about 18 cm tall. Pitchers tended to be bright green with red inside the pitcher and underneath the lid. On some pitchers, white clumps of nectar were present on the underside of the lid. Male flowers were also observed.

Nepenthes x trusmadiensis

This taxon is a natural hybrid between *N. lowii* and *N. macrophylla*, and is found only on Mt. Trus Madi due to the fact that *N. macrophylla* is a Trus Madi endemic. We observed this hybrid only at 3,400 m along the trail (5°33'22.1"N, 116°30'23"E) in two populations, growing as a vine in the trees at an elevation of 2,350 m. Pitchers were large, around 18 cm tall, and a yellow-green colour.

Nepenthes macrophylla

The first population of this species grew between 3,500 and 3,800 m along the trail (5°33'21.1"N, 116°30'23.6"E), with the first individuals occurring at an elevation of 2,410 m. This species was also observed between 3,900 and 4,500 m along the trail, with the highest observed elevation being 2,620 m, at the Repeater. Plants were generally climbing vines in the trees along the trail. Pitchers were very large, up to 30 cm tall, with green or red pitchers.

The overall distribution of *Nepenthes* spp. along the trail to the summit of Trus Madi can be seen in Figure 2.

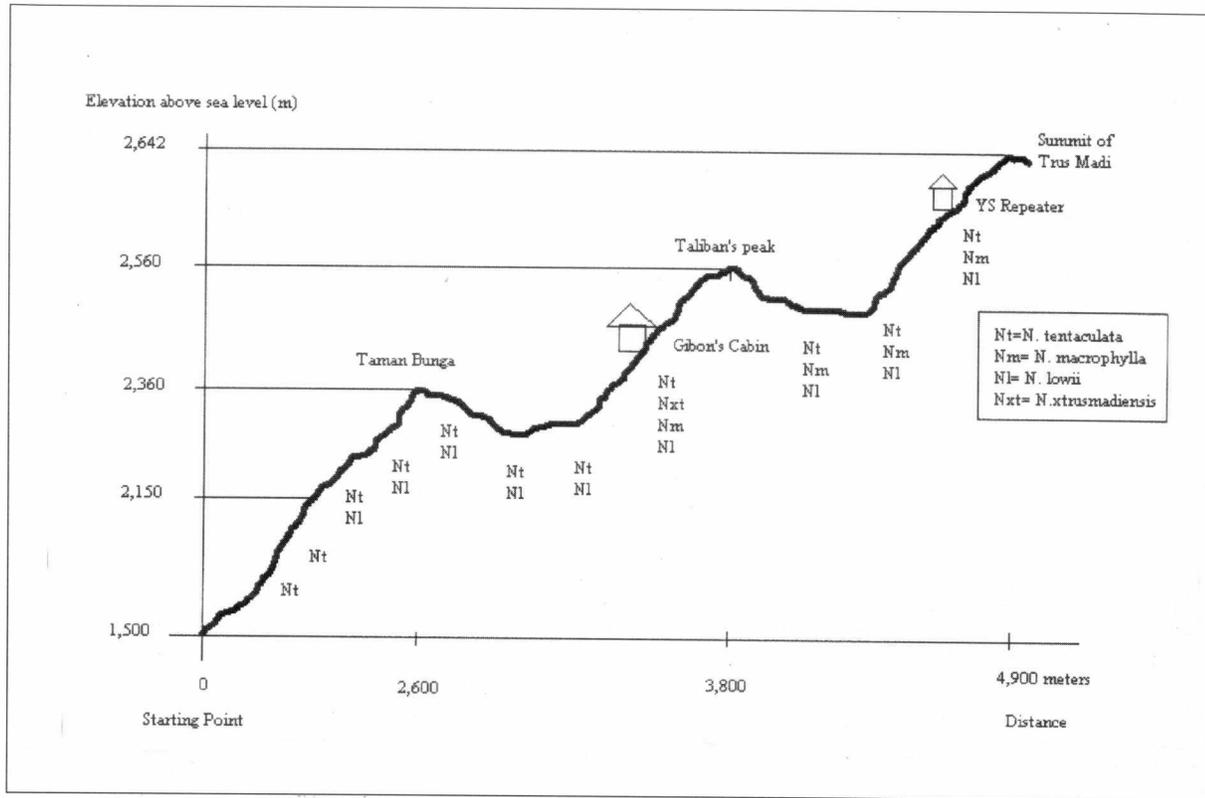


Figure 2. Profile of Mt. Trus Madi along the trail to the summit indicating the distribution of *Nepenthes* spp.

General Remarks

The climb to the summit of Mt. Trus Madi provides a wonderful opportunity for visitors and researchers to see *Nepenthes* in the wild. Mt. Kinabalu may be more famous for pitcher plants, but it is only possible for tourists to see three taxa along the Kinabalu Summit Trail (*N. tentaculata*, *N. villosa*, and the hybrid *N. x kinabaluensis*), and populations along the trail are often damaged or trampled by the large numbers of people who go to see them. In contrast, Mt. Trus Madi has four visible taxa, and the plants are mostly undisturbed and able to grow without much apparent damage from climbers.

Furthermore, *Nepenthes* are present almost everywhere along the Trus Madi trail, and the variability of colour and size of *N. tentaculata* is much greater than that on Mt. Kinabalu, where the plants tend to be small and the colour constrained to shades of green and pink. Visitors might also have the opportunity to witness frog eggs in pitchers of *N. tentaculata*.

Mt. Trus Madi is therefore a “must-see” destination for botanical enthusiasts. However, care must be taken to ensure that the pitcher plant populations remain pristine and undisturbed.

CONCLUSION

In conclusion, there were four *Nepenthes* taxa found along the trail to the summit of Mt. Trus Madi, including three species and one hybrid: *N. tentaculata*, *N. lowii*, *N. macrophylla*, and *N. x trusmadiensis*.

N. tentaculata was found along most of the trail above 1,635 m, while *N. lowii* was found above 2,150 m, and *N. macrophylla* was found above 2,410 m. Two populations of the natural hybrid *N. x trusmadiensis* could be seen at 2,350 m. There were 11 colour combinations of *N. tentaculata* observed along the trail, while *N. lowii* and *N. macrophylla* were more uniform in appearance. In comparison to the *N. tentaculata* of Mt. Kinabalu, we found that *N. tentaculata* forms in Mt. Trus Madi were highly diverse despite the relatively short distance along the trail.

The remarkable variety of *Nepenthes* species on Mt. Trus Madi, as well as the existence of one endemic species (*N. macrophylla*) and one endemic hybrid (*N. x trusmadiensis*) demand that we continue efforts to preserve the populations of these plants on the mountain. In particular, the limited altitudinal ranges of these two endemics and the fact that they only grow on this mountain require that these taxa receive increased conservation attention.

Not only are they at risk from the attention of tourists, but they are also at risk from climate change, which could alter the *Nepenthes* habitats and thereby threaten their future. Continued care and study should be undertaken to monitor risks to *Nepenthes* on Mt. Trus Madi from both tourist damage and climate change to ensure that the plants continue to thrive as they do today.

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Appendix 1. Photographs of *Nepenthes*.

i. *Nepenthes tentaculata* in various colours.



(a) Green with faint red wings, green lip.



(b) Red with green lip, faint spots.



(c) Green with red on lip and wings.



(d) Light yellow green with green lip and red spots.



(e) Pink/red with red lip, darker red spots.



(f) Pink/red with green lip.

ii. *Nepenthes lowii*.



iii. *Nepenthes macrophylla*.



iv. *Nepenthes x trusmadiensis*.



