

## Wild Pitcher Plant (*Nepenthes*: *Nepenthaceae*) in Lowland of Tanjung Selor: A Notes of Diversity, Conservation and Threats

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**Abstract:** Borneo is the second-highest diversity island for *Nepenthes*, with approximately comprising 23 species that were spread on this island. Species found on lowland to highland with variety habitat and ecological types. Tanjung Selor is the capital city of Bulungan Regency, North Kalimantan. *Nepenthes* distribution in these areas has never been reported, particularly in the heath forest. The study was conducted to report the floristic of *Nepenthes* in Tanjung Selor. We used a desktop study and field exploration on heath forest of Tanjung Selor in 2019 with rapid biodiversity assessment method. The preliminary report of *Nepenthes* in Bulungan are presented with species description, ecology, threats, illustration, and a brief discussion regarding the species. We reported six wild species and one natural hybrid of *Nepenthes* based on exploration. *Nepenthes*'s habitat is in an open area, roadside, and heath forest vegetation. The threats are higher from habitat degradation and land conversion to agricultural land or non-agricultural uses. In this paper, we mentioned *Nepenthes fusca* growth in lowland habitat, commonly found in highland.

**Keywords:** Biodiversity, Heath Forest, Kalimantan, Kerangas, Pither Plant

### Introduction

Kantong semar is a tropical pitcher plant and is included in the single genus of *Nepenthes*. *Nepenthes* is a carnivorous plant in the monotypic family (*Nepenthaceae*) that found naturally in the wild and cultivated or hybrids for ornamental plants. The genus consists of 80–87 species and is commonly widely distributed in tropical regions (Cheek & Jebb, 2001; Mansur, 2013; van der Ent, Sumail & Clarke, 2015). Borneo is a center of diversity of *Nepenthes* after Sumatera and the Philippines region, with approximately 34–39 species and 22–24 species being endemic (Cheek & Jebb, 2001; Mansur, 2013; Gronemeyer *et al.*, 2014; van der Ent *et al.*, 2015). *Nepenthes* is beneficial to plant for ornamental plants, and it was cultivated (Mansur 2013), ethnobotanical used, phytopharmacology activities (Sanusi *et al.* 2017), and phytochemical properties have been reported (Mansur, 2013;

Sanusi *et al.*, 2017). The exploration of wild *Nepenthes* for ornamental plants in nature was made, the population declined, and habitat damage was given to efforts to conserve the threatened species in nature.

In the wild, *Nepenthes* commonly found in Kerangas forest (heath forest), peat-swamp forest, and lowland to highlands (including dry lowland forest, montane forest, and limestone) (Adam, Wilcock & Swaine, 1991; Cheek & Jebb, 2001; Lee, 2002; Damayanti, Mansur & Roostika, 2011; Gronemeyer *et al.*, 2014). Tanjung Selor is the capital city of North Kalimantan province located on the side of Kayan river, Bulungan regency. Based on geography, Tanjung Selor is formed by a lowland ecosystem that consists of the kerangas ecosystem (heath forest), swamp, and dry lowland.

Tanjung Selor, as a new capital city, there are many constructions for built-up areas of

government facilities, public facilities, and other facility supports. The new town's development changed natural regions to build a unique ecosystem, for example, an urban ecosystem. They formed a new landscape that removed the native species to introduce species. Development of the areas is immense and accelerates the habitat destruction and biodiversity of native species (Piracha & Macrotullio, 2003). The newly published by Mustaqim & Nisyawati (2020), reported a checklist of the woody species in the urban ecosystem around Jakarta and recorded 118 species of native plants. It is a good question for us, what should we do for Tanjung Selor's biodiversity placed in the future. Ecological disturbs such as forest burning, and deforestation of *Nepenthes* habitats increased the status of critical species in nature (Mansur & Bearly 2008).

Some floristic and ecological studies of *Nepenthes* in Kalimantan have been carried out (Check & Jebb, 2001; Handayani & Astuti, 2005; Mansur & Bearly, 2008; Mansur, 2010; Damayanti *et al.*, 2013; Kissinger *et al.*, 2013; Mansur, 2013; Amanda *et al.*, 2019; Apriyanto *et al.*, 2021), however, none of these studies mentioned the existence of *Nepenthes* in Bulungan. Hence, according to the research that mentioned above this paper aimed to discover and report a checklist of the lowland *Nepenthes* in Tanjung Selor city, Bulungan regency of North Kalimantan. A note of *Nepenthes* in the location gave a preliminary study of the future habitats, diversity, spreading, and conservation plan.

## Material and Methods

### Method and Study Site

The study was conducted with rapid biodiversity assessment (Patrick *et al.*, 2014) in 2019, which is combined the literature studies and field exploration in lowland secondary forest around Tanjung Selor City (Figure 1.).

### Data Collection and Identification

The collection specimens following Rugayah *et al.* (2004). The specimen assessment and validated character following Cheek & Jebb (2001). The results are presented descriptively that consists of species descriptions, photographs

(illustrations), and habitat categories.

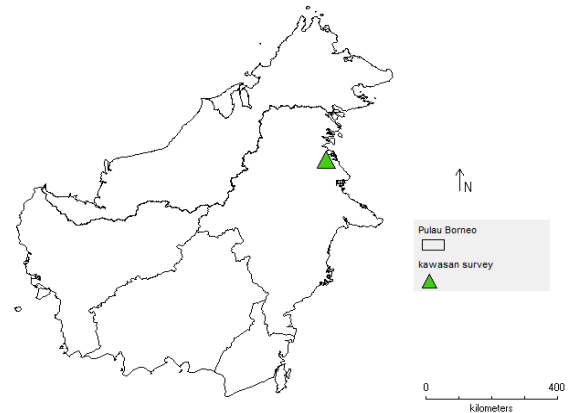


Figure 1. Study site (▲: Tanjung Selor City).  
Source by Diva-GIS

## Results and Discussion

### Diversity of *Nepenthes* in Heath Forest Ecosystem

We reported that six wild species of *Nepenthes* and one natural hybrid were found in lowland secondary forest around Tanjung Selor city (Table 1.).

The lowland species found in open area habitats such as sideroad, bushes after clearing or burning, and some forest types in lowland forest. The species have variations including the pitcher's color and shape as an attractive ornamental (Figure 2.).

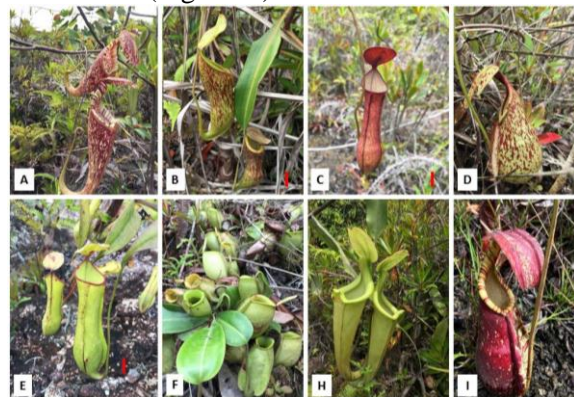


Figure 2. *Nepenthes* in lowland secondary forest of Tanjung Selor City. A. *N. fusca*; B. *N. mirabilis*; C. *N. gracilis*; D. *N. × hookeriana* (*N. ampullaria* x *N. rafflesiana*); E. *N. reinwardtiana*; F. *N. ampullaria*; H-I. *N. Rafflesiana* (H: Upper Pitcher; I: Lower Pitcher). Scale bar: 2 cm (B,C, E). No scale bar (A, D, F-I). Photograph by S. Agustiorini.

Table 1. *Nepenthes* species in lowland of Tanjung Selor city

<i>Nepenthes</i>	Pitcher's Color		Distribution in Kalimantan				
	Lower	Upper	West	Central	South	East	North
<i>ampullaria</i> Jack	Green	Green	Damayanti <i>et al.</i> , 2011; Amanda <i>et al.</i> , 2019; Wardhani, 2020; Apriyanto <i>et al.</i> , 2021	Mansur, 2010	-	-	Ilma, 2014; Agustiorini <i>et al.</i> , 2022
<i>fusca</i> Denser	Dominant purple with vertical greenish stripe		-	-	-	-	Agustiorini <i>et al.</i> , 2022
<i>gracilis</i> Korth.	Green and slightly pale reddish lid	Shiny red and shiny grey or whitish inside pitcher	Damayanti <i>et al.</i> , 2011; Amanda <i>et al.</i> , 2019; Wardhani, 2020; Apriyanto <i>et al.</i> , 2021	Mansur, 2010; Kissinger <i>et al.</i> , 2013; Ikbal, 2020		-	Agustiorini <i>et al.</i> , 2022
<i>mirabilis</i> (Lour.) Druce	Green, sometimes with red lid	Green, redish color	Damayanti <i>et al.</i> , 2011; Amanda <i>et al.</i> , 2019; Wardhani, 2020; Apriyanto <i>et al.</i> , 2021	Ikbal, 2020	-	Handayan i & Astuti, 2005	Ilma, 2014; Agustiorini <i>et al.</i> , 2022
<i>rafflesiana</i> Jack	Red with less bright green stripe, lip redish with greenish stripe	Almost green no ornamental color or stripe	Damayanti <i>et al.</i> , 2011; Amanda <i>et al.</i> , 2019	Mansur, 2010	-	-	Ilma, 2014; Agustiorini <i>et al.</i> , 2022
<i>reinwardtiana</i> Miq.	Reddish & white or grey inside	Reddish & white or grey inside	Damayanti <i>et al.</i> , 2011	-	-	Handayan i & Yuzammi, 2013	Agustiorini <i>et al.</i> , 2022
<i>N. × hookeriana</i> ( <i>N. ampullaria</i> × <i>N.</i> )		Greenish with red stripes	Damayanti <i>et al.</i> , 2011	-	-	-	Agustiorini <i>et al.</i> , 2022

**Notes:** West (West Kalimantan), Central (Central Kalimantan), South (South Kalimantan), East (East Kalimantan), North (North Kalimantan)

## Habitat and Ecology

The landcover of *Nepenthes* habitat regularly is covered by the population of Acacia or wattle trees (*Acacia* sp.) on roadside and bushes containing *Vitex pinnata*.

In habitat, *Nepenthes* growth and associated with *Gleichenia linnearis* (*resam*) that is dominant as well as a report of *Nepenthes ampullaria* habitat in Singapore (Lim *et al.*, 2019) that is dominated scrubland. In Tanjung Selor the Resam population is combined with *Ploiarium elegans* (Bonntinaceae) population, *Lygodium* sp. (Lygopodiaceae), and also Orchids (Orchidaceae) on open land site. *Nepenthes* lifeforms are climbing on the trees or shrubs and rosette forms on the ground.

The species was found in the kerangas ecosystem (dry heathland) around Tanjung Selor city. Kerangas ecosystems were secondary forest habitat and disturbed bushes along the roadside. The landscape is undulate, consisting of red soil, white sandy soil, and semi-clay on the bushes site.

Most habitat types of *Nepenthes* was reported in many articles *i.e.*, a kerangas ecosystem (Kissinger *et al.*, 2013; Hidayati, 2018), peatland (Wardhani, 2020), lowland (Rizqiani *et al.*, 2018), highland ecosystem (Van der Ent *et al.*, 2015; Damit, Nilus, & Sulaeman, 2017), lakeshore habitat (Dino, Astiani, & Kartikawati, 2016), and peat-swamp ecosystem (Mansur, 2010).

## Conservation and Status

Mansur (2013) mentioned the conservation of *Nepenthes* in Indonesia that the principal suggestion of *Nepenthes* conservation and conservation action is preserve the threatened and rare species. Commonly, the conservation status of species and endangered plants in Indonesia followed the national red list regulation and adopts international regulation such as global red list species from the IUCN database and CITES data (Mansur, 2013; Rahman, 2015; Nainggolan, Dewi, dan Darmawan, 2019).

Based on the red list of threatened species in 2014 and 2018 by IUCN, the conservation status of the species is the least concerned (LC) category. The status population trend is unknown for *N. ampullaria*, *N. fusca*, and *N. rafflesiana*, increasing natural population for *N. reinwardtia*,

*N. gracilis*, and *N. mirabilis*. In a while, CITES listed the wild species of *Nepenthes* spp. Into protected trade and have to get permission from the country to trade outer the native land. Indonesian government protected *Nepenthes* under Ministry of Forestry and Environment regulation on Permen LHK/P.106 Tahun. 2018, *i.e.*, 59 species that are spreading in Indonesia. *N. fusca* is a protected species included in the appendix of the regulation (MoEF LHK 106 2018).

## Threats

In study site, *Nepenthes* species are relatively not popular locally for garden plants or economic plants. However, the diversity of *Nepenthes* becoming are threats from deforestation, degradation land, and lost habitat after established the capital city of North Kalimantan province. The *Nepenthes* habitat generally very close to the capital city development had been a risk become decreasing the population and the diversity. According to Mansur (2013), the population decreasing of *Nepenthes* in habitat being from the forest burning, mining activities, deforestation, and over exploitation.

North Kalimantan has a defecient data of *Nepenthes* flosristic and ecological data, particulaly outside the Tarakan Island. In recent years, the researchs of *Nepenthes* in Kalimantan was reported and mainly conducted in Western Kalimantan (West Kalimantan and Central Kalimantan) (Tabel 1.). Our study recorded six species in the wetland habitat and one natural hybrid. The number of *Nepenthes* species on the study site is relatively more than the number of species that was reported in Belitung Island, that is consists of five species and one natural combination in the heath forest (kerangas ecosystem) (Rizqiani *et al.*, 2018), compared to West Kalimantan on 12 regencies reported 12 wild species (Damayanti *et al.*, 2011). In Central, Kalimantan has been recorded as nine species (Mansur, 2007).

Ornamental color of the *Nepenthes* pitcher allowed in cultivation and ex-situ conservation to build a source phenotype or gen of hybridization *Nepenthes*. We found the ornamental pitcher on *N. reindwardtiana*, *N. gracilis*, *N. rafflesiana*, *N. fusca*, and *N. hookeriana*. Especially, *N. fusca* is unusual found in lowland habitats; Jebb & Cheek



(1997) clarified that this species is commonly found in highland with range 1 200–2 500 m asl.

The hidden sites of *Nepenthes* from local people give a benefit for their diversity and population. Development of Tanjung Selor being a new capital city, we estimated that the *Nepenthes* habitat in these sites would be lost for five or ten years. Recent issues: The sites are being a master plan of new real estate property development area. This is good news for business but bad for our biodiversity.

## Conclusions

The preliminary study reported six *Nepenthes* species and one natural hybrid from the Kerangas ecosystem that found around Tanjung Selor City. *Nepenthes fucosa* was interesting information that is found in lowland habitats. The species is relatively spreading on a highland with an altitude higher than 1000 m asl. The conservation status of the species under CITES regulation and the Indonesia Government under P.106 Tahun. 2018 to protect *N. fucosa*. In the future, the threats from deforestation and degradation the habitat to be the real estate area and the establishment the capital city of North Kalimantan.

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