Proceedings
The 4th International
Carnivorous Plant Conference
Tokyo, Japan 2002 ©

D-1

Ecology and diversity of pitcher plants in Sarawak

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ABSTRACT. The study to determine the diversity and the distribution of *Nepenthes* in Sarawak base on the examination of herbarium specimens as been carried out. Endemic species recognized includes *N. bicalcarata, N. curtisii, N. faizaliana, N. fusca, N. hirsuta, N. lowii, N. muluensis, N. northiana, N. pilosa* and *N. veitchii.* Pitcher plants recorded outside Borneo identified include *N. albomarginata, N. ampullaria, N. gracilis, N. mirabilis, N. rafflesiana, N. reinwardtiana* and *N. tentaculata.* Species with rare occurrence or confined to a particular type of forest are *N. northiana* (Bau and limestone endemic), *N. muluensis* (Mount Mulu and Mount Murud), *N. faizaliana* (Bukit Panjang in Mulu), *N. fusca* (Mt. Apo in Kelabit Highland). Seven species occurring outside Borneo are generally widely distributed in Sarawak. The habitat depending on species can be found growing on roadside clearing, heath forest, secondary scrub, peat swamp forest, forest underlying ultrabasic and limestone outcrop, gap of dipterocarp primary forest, mossy forest.

INTRODUCTION

Nepenthes belonging to family Nepenthaceae contained 81 species in the world (Adam, 1995). This tropical family has the center of distribution in Borneo, Malay Peninsular, Sumatra, Philippines and New Guinea. It can found eastwards up to New Guinea and Isles of Pines, westwards to Sri Lanka, Seychelles and Madagascar, absent in the African continent, southwards it can be found in the York Peninsular, Queensland in Australia, and northwards to Khasia Hill in Assam, Indo-China and Southern China. Pitcher plants are climbers and scramblers. They are terrestrial plants but some species may grow epiphytically on trees. One of the main characters of the genus is the presence of pitchers variously shaped, colored, and sized on their tendril tips. Their flowers are arranged along the axis called inflorescence. The plants are dioecious, their male and female inflorescence are borne on different plants. The flowers secreted nectar from the glands on the upper surface of the flower sepal; the nectar emitted a weak foetid smell as to attract potential pollination agents such as the ants and flies. The ability of pitcher plants growing in low nutrient soil is attributed to their carnivorous habit. It is achieved by the modification of leaves into pitchers on the tip of the tendrils. The pitchers have the ability to attract potential prey by variously colored, shaped and sized of the pitchers, secretion of nectar from the lid nectar glands and marginal glands situated in between peristome teeth. The effectiveness of the trap is enhanced by the presence of slippery waxy layer of the upper half on the inner pitcher cavity in most but not in all species.

Materials and Methods

Information on the ecology, altitudinal distribution, localities and morphological similarity and differences between species were obtained from the herbarium specimens examined from various herbaria: K, L, BO, UKMB, UKMS, SAN, SAR, SING, FRI, BRIS, and my personal collection from Sarawak. The information for endemic species and species occurring outside Borneo was gathered from field observations, and aided by literatures (Macfarlane, 1908; Danser, 1928; Holttum, 1940; Kurata, 1976; Turnbull and Middleton, 1981; Hotta and Tamin, 1986; Som, 1988; Adam *et al.*, 1992)

Results and Discussion

Endemic species

Nepenthes bicalcarata This species is very closely related to *Nepenthes ampullaria* but differ from this species and other species of the family by the presence of two incurved thorns on the lid base of upper and lower pitchers. It is recorded in Sarawak from Betong Forest Reserve, Baram, Loba, Kavang South Forest Reserve, Penyilam Bintulu, Lawas River, Merapok and Marudi. It occurs from about 10 m to 30 m altitude in disturbed primary forest, in after-logged forest growing together with *Nepenthes ampullaria*.

Nepenthes curtisii This species has been collected from Gunung Silantek in Sri Aman, Carapa Pilla Mujong Watershed in Balleh, Gunung Api, Bukit Banggai at Sungai Lemanak, Bukit Sekanjang in Lanjak Entimau, Mount Penrissen, Gunung Pueh in Lundu, Mount Mulu, Mount Berumput, Mount Poi and Mount Murud. This highland species occurs from 900 m up to 1650 m altitude in mossy forest, exposed mountain ridges, montane scrub vegetation. This species is morphology related to *Nepenthes fusca* by the presence of glandular crest at the base of the pitcher lid below but differs by the presence of extended apical appendages of lower lid surface.

Nepenthes faizaliana This species is found from Bukit Panjang in Mulu. It is morphologically similar with *Nepenthes fusca* by its infundibulate upper pitcher, presence of glandular crest on the lower lid surface, semi-amplexicaul leaf base but differs in having two-flowered pedicels and partly glandular upper pitcher.

Nepenthes fusca This species has very rare occurrence, being recorded on Summit of Mount Apo Dari in Kelabit Highland. It is similar with *Nepenthes curtisii* by the presence of glandular crest on the lower lid surface but differs by the absence of extended apical glandular appendages on lid surface below.

Nepenthes hirsuta This species has been collected from Bungoh Range, Teluk Pasir in Santubong, Sungai Sengkeli, Kg. Kara, Belaga, Lawas, Lambir National Park in Miri, Mount Serapi, Mount Dulit, Hose Mts, Bukit Lumut, Sugai Lemanak, Balleh, Gunung Pueh Forest Reserve, Kota Forest Reserve in Lawas and Mount Santubong. It can be found from 100 m altitude up to 1500 m. It grows in heath forest, beach vegetation and montane mossy forest. It is different from the other species in having hirsute hairs on almost parts of the plants.

Nepenthes lowii It is found widespread in montane forest of the northeastern part of the state, which includes Mt. Murud, Mt. Mulu, Gunung Api, Bukit Lawai; it has been collected only on Bukit Temedu in western part of the state. It is a highland species occurring from 900 m to 2200 m altitude. It is a common climber of mossy forest but may also be epiphytic on tree; it is found scrambling in ericaceous scrub of montane vegetation. It is similar to *N. ephippiata* in having numerous bristles on lower surface of pitcher's lid but differs in having inconspicuous peristome rim and ribs of the upper pitcher.

Nepenthes muluensis The author has collected this species from Mount Mulu and Mount Murud. It grows together with *Nepenthes tentaculata* in exposed scrub vegetation on the summit trail of both mountains from 1700 m to 2400 m altitude. It is related to *Nepenthes tentaculata* by it racemes inflorescence and simple flower pedicel, inner surface

of pitcher partly covered with exposed digestive glands. It differs from this species in having cylindrical stem, semi-amplexicaul leaf base, and marginal hairs on pitcher lid absent. These two species hybridized naturally on Mt. Mulu, forming a hybrid (Adam and Wilcock, 1992a)

Nepenthes northiana It has been collected from altitude 30 m to 200 m from several limestone hills in Bau Kuching District, which includes Seburan, Mount Tabai, Bukit Numpang, Bukit Kapor and Bidi Caves. It grows commonly in cervices overhanging semi-shaded vertical walls of limestone and gentle slopes in damp habitats.

Nepenthes pilosa It is a rare species in Sarawak. It has been collected once from Bukit Buli in Bario in mossy forest at 1600 m altitude. This species is very distinctive in having most parts of the plants densely covered with reddish-brown pilose hairs.

Nepenthes veitchii This species is recorded from Lawas Kayangeran Forest Reserve, Ulu Lawas Merapok, Ulu Tiang and Balleh, River Kenaba Upper Plieran, Bukit Berar, Ulu Sungai Kakus in Bintulu, Nanga Semparajah in Ulu Mujong, Mount Lesong, Mount Santubong, summit of Mount Lesong, Bukit Lumut in Ulu Mujong, Sungai Masia in Karangaran Forest reserve, between Mendalam and Terikan Rivers in Mulu, Mount Dulit, Ulu Melinau Fall, Batu Buli in Bario, Mount Mulu. It grows epiphytically on trees in low and high altitude mossy forests between 500 m to 1800 m. This species can easily be identified in the field by its epiphytic habit and unusual broad peristome of pitcher.

Species distributed outside Borneo

Nepenthes albomarginata This species differs from other species in the family by the presence of white velvety band around its pitcher mouth. It is occurring in Borneo, Peninsular Malaysia, Singapore and Sumatra. The distribution of the species is widespread and it has been collected from many parts of Sarawak which include Mt. Santubong, Loba Vebay Forest Reserve, Bukit Braag, Rantau Panjang, Teku, Bau (Bidi Cave, Bukit Jambusan, Bukit Jebong, Bukit Kapor), Bako Park (Telok Assam, Lakei Islands), Bawang, Mount Staar, Mount Bungoh, Mount Aping, Mount Matang, Mount Tiang Lake, Mount Mururong, Miri (Lambir Hill Summit). It is commonly in lowland area below 500 m altitude and sometimes can grow at higher altitude up to 1000 m. It grows in heath forest, along the coast on rock face, limestone vegetation, secondary scrub and mossy forest on low altitude mountain.

Nepenthes ampullaria This species is morphology related to *Nepenthes bicalcarata* by its paniculate inflorescence, urceolate lower pitcher, wholly glandular with overarched gland on pitcher inner surface but differs from the latter species in having very narrow deflexed pitcher lid, absence of two incurved thorns on the lid base and bracteolate flower pedicels. This is a common species in Sarawak; it has been from Bako Park, Sungai Dua Baram, Pulau Bruit, Kayangkeran Forest Reserve, Kelapaan, Sungai Raya, Selalang Forest Reserve, Bawang, Bau, Tebuan Hilir Kuching, Sungai Tutus, and Sebanding Forest Reserve. It is a lowland species, commonly grows below 100 m altitude but may grow up to 600 m altitude. It is a common plant on roadside clearing, heath forest, margin of secondary swamp vegetation, peat swamp forest, c sometimes found within the gap of tall canopy lowland dipterocarp forest.

Nepenthes gracilis This species occurs in most part of the state, which includes Batang Baram, Bau, Batu Kawa, Bako Park, Bawang, Betong-Saribas Forest Reseve, Bukit Sampadan Kuching, Lambir Miri, Lundu, Marudi, Matang Road Kuching, Melugu, Mount Matang and Sungai Rayu. It is a lowland species, commonly found below 500 m altitude but may occurs up to 1200 m altitude. This species is closely related to *Nepenthes reinwardtiana* by its triangular stem, winged leaf base, pitcher shape and partly glandular pitchers but differs in having racemes inflorescence, simple flower pedicels, inner pitcher cavity covered with exposed digestive glands, lower lid scarcely covered with nectar glands and the absence of two big black spots on the pruiose zone on the inner cavity surface of upper and lower pitcher.

Nepenthes mirabilis It grows extensively in damp habitats or swampy areas, fringes of swampy vegetation, in secondary vegetation and on roadside clearing. It is one of the

common lowland species encountered in Sarawak; it has been collected from Bawang (*N. mirabilis* var. *biflora* Adam and Wilcock, 1992b), Kuching area, Bau area, Lundu, Betong, Sg. Rayu, Pedawan, Wau, Balulo and Sematan. It is found growing from sea level to 500 m and rarely up to 1000 m altitude.

Nepenthes rafflesiana The distribution of the species in Sarawak is widespread. It has been collected from Matang, Lobok Pasar, Batang Baram, Sungai Bintawa, Rantau Panjang, Teku Road, Lundu, Kuching, Bako, Bukit Tambi, Baram, Lambir Hill, Bukit Lumut, Carapa Lop in Ulu Mujong Balleh and Mt. Aping. It can be found from sea level up to 1000 m altitude. It grows in heath forest, secondary vegetation on roadside clearing, low altitude mossy forest, and gap of dipterocarp forest, peat swamp forest and Padang keruntum forest.

Nepenthes reinwardtiana This species has been collected from Lawas Kayangeran Forest Reserve, Pa' Ukat Bario, Hose Mt., Nanga Pengiran in Balleh, Pelagus Rapid in Belaga, Bako National Park, Upper Rejang River, Sungai Bena in Kapit, Mount Dulit. It can be found commonly at low altitude and may be found up to 1300 m above sea level. It grows commonly on roadside vegetation or bare ground on steep or gentle slopes, growing epiphytically on trees, in montane mossy forest and coastal rock faces. It is related to *Nepenthes gracilis* by its sessile leaves, winged lamina base and triangular stem. It differs from other species by the presence of two black round spots on the waxy zone on the inner pitcher cavity.

Nepenthes tentaculata It is widely distributed on the mountain forest of Sarawak between 800 m to 2100 m altitude. It has been collected from Mount Berumput, Mount Mulu, Mount Api, Ulu Balleh, Mount Tibang, Hose Mts, Mount Dulit, Ulu Anap, Bukit Temedu, Mount Bungoh, Meruruon Plateau in Bintulu, Bukit Sekanjang, Mount Poi, Mount Santubong, Mount Matang, Bukit Sempadi in Kapit, Bukit Lawi, Mount Dulit, Mount Serapi and Mount Penrissen. It is a common species on the top half of Mount Murud; and this species has been recognized as *Nepenthes murudensis*. It is closely related to *N. muluensis* but differs in having triangular stem and winged lamina base.

Acknowledgements

I wish to thank Universiti Kebangsaan Malaysia, Tabung Biodiversiti FSSA, IRPA 4-07-03-042 & 56 for sponsorship; herbaria K, L, BO, UKMB, UKMS, SAN, SAR, SING, FRI, BRIS for their permission to examine specimens; Mr. Julaihi Adam and Mr. Aliosman Mahdi for assistance in the field; Pn. Aspah for typing the manuscript.

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