

## Ecological Survey of Terrestrial Orchids in Malaysia

by

Takayuki TANAKA\*, Saleh KADZIMIN\*\*, Naohiro ANDO\*\*\*, Yukitaka YAMAGUCHI\*\*\*\*  
and Takayuki MIZUTANI\*

田中孝幸\*・サレー・カズィミン\*\*・安藤尚弘\*\*\*・山口行孝\*\*\*\*・水谷高幸\* :  
マレーシアの地生ランに関する生態学的研究

Malaysia is known for her lush tropical rainforests covering the large portion of the peninsular and the northern coast of the island of Borneo. Malaysia is also known for her beautiful orchid species such as the *Vanda* and *Phalaenopsis* found in their natural habitats as well as in cultivation. With the country's fast development towards industrialization, large tracts of the rainforests, like elsewhere, have been lost due to lumbering and other human activities.

Orchids belong to the largest family of flowering plants, the Orchidaceae, which includes some 19,500 species in 804 genera (Dressler 1993). Of these, 854 species covering 141 genera are said to be indigenous to Peninsular Malaysia (Seidenfaden and Wood 1992) and over 1400 species in 147 genera to Borneo (Chan *et al.* 1994). Many of the orchid species, for example, the *Paphiopedilum* and *Vanda* are so showy that they are said to be in extinction in their natural habitats due more to horticultural collections than developmental activities. Even other inconspicuous orchids are also endangered because of their horticultural value as rare plants. As such, most of the orchid species are now listed as endangered species (Pritchard 1989, Reid and Miller 1989, Waite 1989, Wood 1989).

Although terrestrial orchids are less popular as commercial or ornamental plants compared to epiphytic orchids, many of them are equally attractive and worth preserving as germplasm for breeding purposes. Among these, *Spathoglottis plicata*, *Arundina bambusifolia* and *Calanthe triplicata* were selected for studies on conservation, breeding and artificial micropropagation. The justifications are; 1) they are hardy and beautiful as pot plants or as garden orchids; 2) because they are not as popular as *Phalaenopsis* or *Dendrobium*, they are not propagated *in vitro* but collected direct from their natural habitats, hence making them endangered; 3) they are widely distributed both in Japan and in South East Asia and research fields are still available.

Ecological survey of the wild orchids (Wells and Willems 1991) is useful for not only their conservation but also their cultivation. In the present study, the authors focused on the genus

\*School of Agriculture, Kyushu Tokai University, Kawayo, Choyo, Aso, Kumamoto, 869-14. 九州東海大学農学部. 〒869-14 熊本県阿蘇郡長陽村河陽.

\*\*Department of Horticulture, Universiti Putra Malaysia, 43400, UPM Serdang, Selangor, Malaysia. マレーシア・ブトラ大学園芸学部. マレーシア, セランゴ, セダン43400.

\*\*\*Green Tech Tokyo Co., Ltd., Wisma Genting, Jalan Sultan, Ismail 50250, Kuala Lumpur, Malaysia. (株)グリーンテック東京. マレーシア, クアラルンプール, イスマイル, ジャラン・サルタン, ウィスマ・ゲンティング50250.

\*\*\*\*Dogashima Orchid Center, 961-30, Kadokaru, Ishikawa, Okinawa, 904-11. 堂ヶ島洋らんセンター. 〒904-11 沖縄県石川市嘉手苺 961-30.

*Spathoglottis* considering its presence in the natural habitats as well as the ecological conditions in which it grows.

The genus *Spathoglottis* consists of about 40 species, widely distributed in the regions from India, southern Japan and China, down through the islands of the Pacific and northern Australia (Seidenfaden and Wood 1992). In Malaysia, six and seven species of the genus *Spathoglottis* grow wild in peninsular and Borneo, respectively. *S. plicata* is the most common species in the genus found growing either in the lowlands or elevated areas of Malay Peninsular and Borneo, Malaysia and Iriomote Island, southern part of Japan. The flowers of *S. plicata* can be in different shades of purple including white, as well as variations in shapes which attract collectors.

### Ecological survey

Two ecological surveys were carried out at Genting Highlands in Peninsular Malaysia mainly on June 26, 1996 and Mt. Kinabalu in the island of Borneo on June 29, 1996. Fig. 1 shows the points of the ecological surveys conducted. The data were compared with those previously collected from Iriomote Island, Okinawa, Japan (Tanaka and Mizutani 1995). Quadrats were set at the locations where *Spathoglottis* species were found to be growing wild. The considerations taken into account in each quadrat were habitats, altitude, exposure, land inclination, light intensity, soil type, soil humidity, vegetation and coverage of plants.

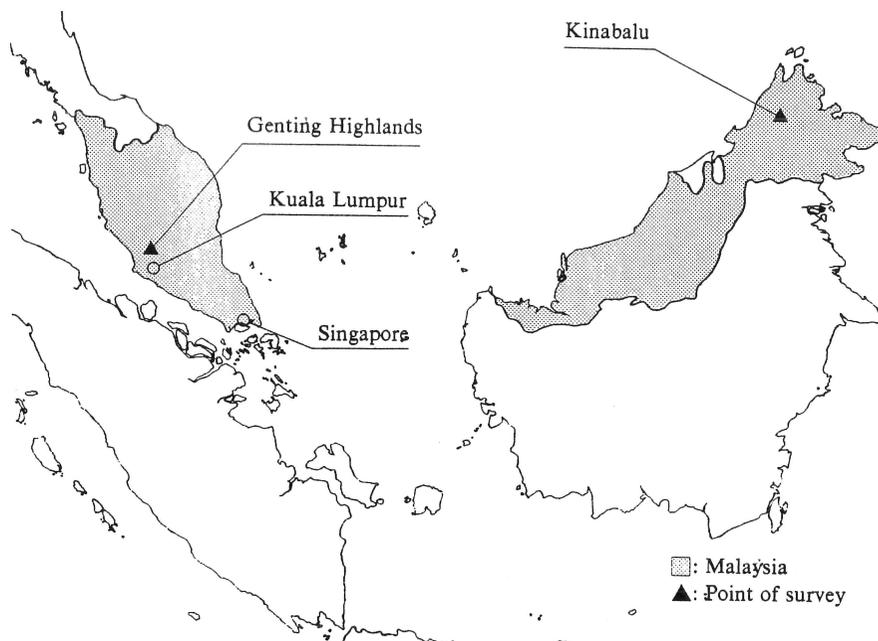


Fig. 1. Map of point of vegetation survey in Malaysia.

### Results and Discussion

#### 1. Climate and general vegetation

In the present study, the authors surveyed the ecological conditions of the wild orchids focusing

the genus *Spathoglottis* at two locations: Genting Highlands in Peninsular Malaysia (West Malaysia) and Mt. Kinabalu in Borneo (East Malaysia).

### Mt. Kinabalu

Mt. Kinabalu is the highest peak (4,101m) in Southeast Asia and is known for its well preserved complete spectrum of plant life, which embraces tropical lowland rainforest, tropical mountain forest, tropical moss forest and tropical alpine vegetation all packaged in one locality. In each vegetation, incredible biodiversity or species rich forest were observed and over half of the species growing above 900 m are said to be endemic.

At elevation lower than ca. 900 m elevation, hot climate and an average annual rainfall of 2,500 mm favors tropical lowland rainforest with its huge *Dipterocarpus* trees and biodiversity with various foliage levels under the top canopy. Between 900 m and 1,800 m elevation cooler temperature, the better light penetration and higher moisture produce denser ground cover and an abundance of epiphytes such as orchids and mosses growing on tree trunks than the lowland forest. At 1,588 m (Park headquarters), daily temperature varies from 20°C to 13°C at night.

Tropical moss forests started at a distinctively cold 1,800 m elevation where the annual rainfall hit 4,570 mm and thick mosses, lichens, orchids were found hugging to stunted tree trunks. As a matter of fact, it was difficult to find a tree without any epiphytic orchids. Several *Rhododendron* and *Nepenthes* (Pitcher plant) also grew wild attracting the interest of the horticulturists. Beyond the moss forest, under extreme temperature, violent winds and driving sleets at the summit zone, there exist tropical alpine forest with low diversity plant life.

Table 1. Description of quadrats set up in Genting Highlands (Myg) and Kinabalu (Myk), Malaysia and Iriomote island (Jpi), Japan

Quadrat			Habitat	Altitude (m)	Exposure	Inclination	Light intensity (klux)	Top soil	Soil humidity
name	target	size							
Myg-1	<i>S. plicata</i>	1m×1m	Road-side flat	1,170	—	0	89	Laterite	Moderate
Myg-2	<i>S. plicata</i>	3m×3m	Road-cut slope	830	E	67	89	Laterite	Bad drainage
Myg-3	<i>S. aurea</i>	3m×5m	Road-cut slope	1,540	SE	42	89	Laterite	Bad drainage
Myk-1	<i>S. plicata</i>	5m×5m	Road-side slope	1,475	NE	10	89	Rock and laterite	Bad drainage
Myk-2	<i>S. microchilina</i>	3m×5m	Road-cut slope	1,570	ESE	44	90	Laterite	Moderate
Jpi-1	<i>S. plicata</i>	5m×5m	Road-cut slope	60	SE	60	20	Clayslate	Dry
Jpi-2	<i>S. plicata</i>	3m×3m	Road-cut slope	240	NE	20	1.3~20	Red loam	Bad drainage

### Genting Highlands

Genting Highlands is situated 50 km from Kuala Lumpur. The Highlands has grown to become a biggest highland resort. After 1969, it has also become the main recreation center in Malaysia, which attracts not only the casino players but also the people who want to escape from the hot and humid lowlands, because at 1,711 m above sea level, the air is cool and invigorating. The weather is generally very cool whereas in the evening it can get misty all year round.

#### 2. Quadrat survey

In each location, the survey found two *Spathoglottis* species: *S. plicata* Blume and *S. aurea* Lindl., and *S. plicata* and *S. microchilina* Kraenzl., growing wild. These species are among the known six species of the genus found in Peninsular Malaysia (Teo 1995), and among seven species found in Borneo Island (Chan *et al.* 1994), respectively.

#### *Spathoglottis plicata*

Table 1 is a summary of the conditions of the quadrats showing the habitats in which the *Spathoglottis* were found. In both locations, the species were found in open spaces with high light intensity (90 klux) generally on the slopes formed by road construction in the mountainous area. In Malaysia, even *S. plicata* grew wild at high elevation, but generally not higher than ca. 1,500m. In Iriomote Island, Japan, *S. plicata* was found in the lowland at about 60 or 240m above sea level. In the lowland of Malaysia, encroachment of industrial development as well as large-scale plantations have minimized the natural habitats for *S. plicata*.

In Iriomote Island, *S. plicata* was frequently found growing among two other species sharing similar habitat, *Dicranopteris*, a semi-climber fern, and *Arundina*, a tall grass terrestrial orchid with *Cattleya*-like flowers. In Genting Highlands, both of these species looked stronger and bigger (about 2 m) than those in Japan and seemed to dominate the places where *S. plicata* had grown.

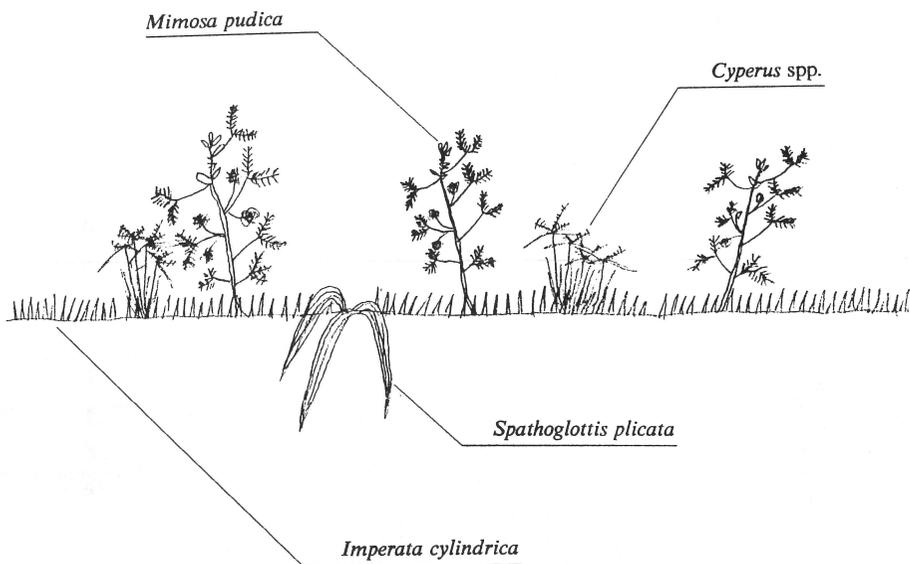
The quadrat, Myg-1, is the road-side shoulder at 1,170 m elevation in Genting Highlands next to the dense *Dicranopteris* and *Arundina* grassland where *S. plicata* was not found. There was one *S. plicata* plant recovering from the damage of the shading by removing the canopy of the tall grasses but in return the mowing also severely damaged the plant. The open spaces consisted of short grassland of *Imperata cylindrica* which was most dominant, *Mimosa pudica*, *Cyperus* spp. (Table 2 and Fig. 2) and *Ipomoea cairica* surrounded by *Cyathea* and *Ficus* undergrowth (data not shown).

The quadrat, Myg-2, was a cut-slope of a road at 830 m elevation where vigorous *S. plicata* were found growing. They were blooming flowers, bearing seed pods and dispersing seeds simultaneously. It seemed that *S. plicata* was more competitive against *Emilia sonchifolia*, *Crassocephalum ciepidioides* although some climbing plants such as *Mikania micrantha* were seen to be shading them (Table 3 and Fig. 3). However, the tall competing species such as *Dicranopteris* and *Arundina* or woody plants had not established at the place yet.

In the island of Borneo, the quadrat, Myk-1, was located at 1,475 m elevation along a road to Mt. Kinabalu. At this location, *S. plicata* survived among *Arundina graminifolia* grassland (Table 4 and Fig. 4). The habitat was too humid for other weed species to grow except for three small fern species and *Imperata cylindrica*. The *A. graminifolia* there was seen bigger (2.5 m) than those in the Peninsular and in Iriomote Island although rather scattered in existence. It seemed that *S. plicata* plants had enough sun for normal growth and development. This observation tends to imply that *S.*

Table 2. List of plants found growing in quadrat (Myg-1) with *Spathoglottis plicata* in Genting Highlands

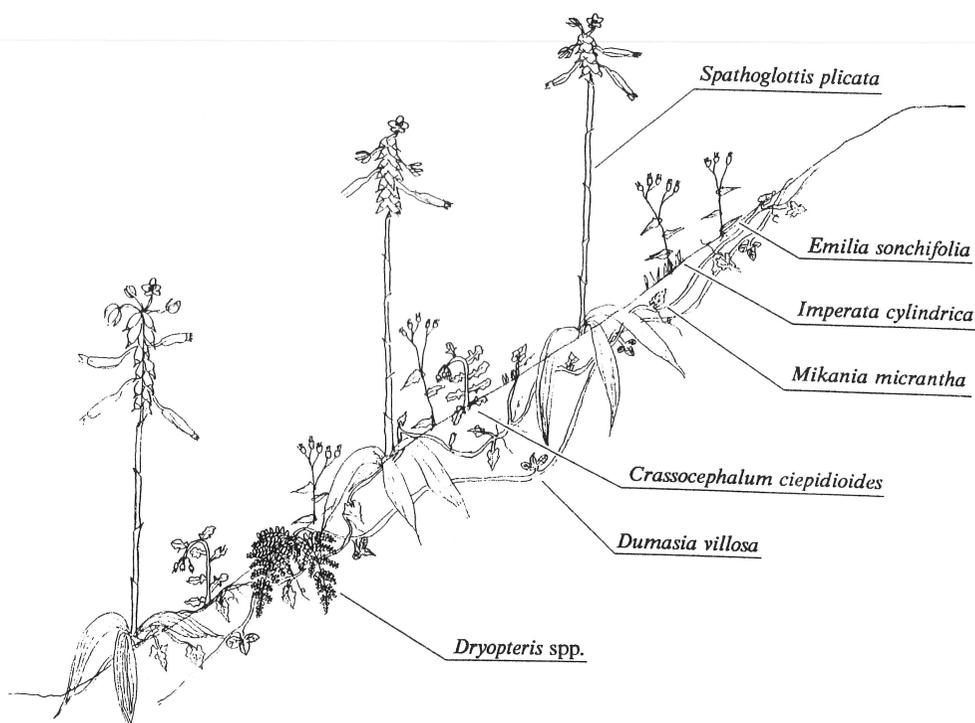
Scientific name	Japanese name	Coverage	No. of plants
Orchid			
<i>Spathoglottis plicata</i>	コウトウシラン	1	1
Herb			
<i>Imperata cylindrica</i>	チガヤ	5	
<i>Cyperus</i> spp.	カヤツリグサの仲間	1	
<i>Mimosa pudica</i>	オジギソウ	2	

Fig. 2. Profile diagram of vegetation where *Spathoglottis plicata* was found in Genting Highlands (quadrat Myg-1).

*plicata* had survival strategies making it a leading plant species in succession; 1) It invades the open spaces formed by development such as road construction or natural disaster such as landslide; 2) It is taken over by taller shrubs, woody plants or even grasses depriving it from direct sunshine; 3) It easily sets seed pods (capsules) by self-pollination (data not shown) bearing thousands of minute winged seeds that move to new habitats. Teoh (1989) also reported that *S. plicata* seeds were recovered after thirteen years after the famous eruption (1883) of Mt. Krakatoa, Indonesia, which destroyed every flora on the island. Unlike other orchid species, *S. plicata* spreads its distribution along with land development, especially road construction. While the cultivation of *S. plicata* is fairly easy. Being an attractive species, the *S. plicata* becomes easily vulnerable to collection by plant collectors for horticultural purposes. Comparing with Iriomote Island, one of the Japanese National Park, the lowland of the Peninsular Malaysia is much developed, making *S. plicata* more endangered.

Table 3. List of plants found growing in quadrat (Myg-2) with *Spathoglottis plicata* in Genting Highlands

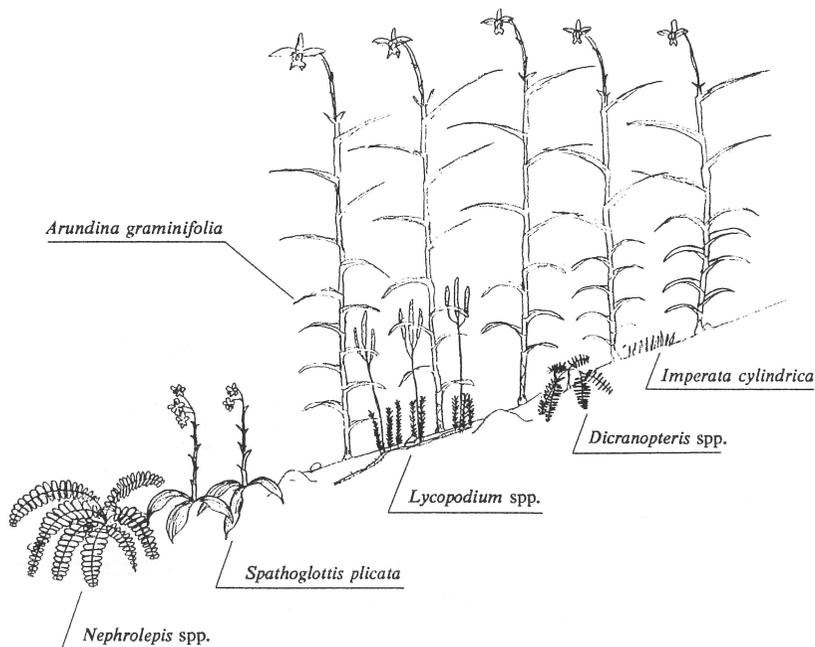
Scientific name	Japanese name	Coverage	No. of plants
Orchid			
<i>Spathoglottis plicata</i>	コウトウシラン	2	16
Herb			
<i>Dryopteris</i> spp.	ベニシダの仲間	1	
<i>Emilia sonchifolia</i>	ウスベニニガナ	1	10
<i>Crassocephalum ciepidioides</i>	ベニバナボロギク	1	4
<i>Imperata cylindrica</i>	チガヤ	1	
Climber			
<i>Mikania micrantha</i>	キク科の一種	3	
<i>Dumasia villosa</i>	ノササゲの仲間	3	

Fig. 3. Profile diagram of vegetation where *Spathoglottis plicata* was found in Genting Highlands (quadrat Myg-2).***Spathoglottis aurea* Lindl. and *S. microchilina* Kraenzl.**

In the survey, the authors found two other *Spathoglottis* species in the Malay Peninsular and Borneo, both of which bear golden yellow flowers. The distributions of the two species did not overlap with *S. plicata*. They were found growing wild at elevation higher than 1,500 m above sea level. Generally the temperate, higher than 1,500 m above sea level, is too low for the tropical lowland plants

Table 4. List of plants found growing in quadrat (Myk-1) with *Spathoglottis plicata* in Kinabalu

Scientific name	Japanese name	Coverage	No. of plants
Orchid			
<i>Spathoglottis plicata</i>	コウトウシラン	1	5
<i>Arundina graminifolia</i>	ナリヤランの仲間	5	
Herb			
<i>Imperata cylindrica</i>	チガヤ	2	
<i>Dicranopteris</i> spp.	コシダの仲間	1	
<i>Nephrolepis</i> spp.	タマシダの仲間	1	
<i>Lycopodium</i> spp.	ヒカゲノカズラの仲間	2	

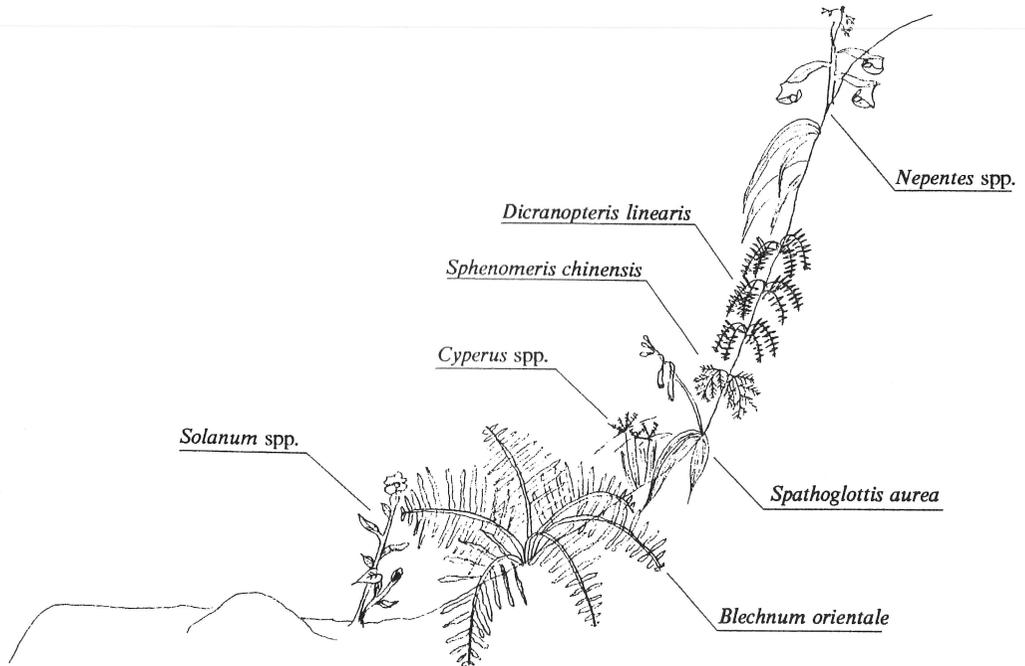
Fig. 4. Profile diagram of vegetation where *Spathoglottis plicata* was found in Kinabalu (quadrat Myk-1).

and the flora of the two locations were quite different from each other.

*Spathoglottis aurea* Lindl. was also found growing in the Myg-3 on a road-cut slope (1,540 m) to the Genting Highlands (Table 5 and Fig. 5). It grew with *Nepenthes* spp., *Sphenomeris chinensis* and some other herbaceous species. It seemed to grow in avoidance to competition with *Dicranopteris linearis*. However, no *S. aurea* was found near the top of the Genting Highlands, whereas some *S. aurea* plants were found on the top of Fraster's Hill, at 1,524 m above sea level, which located 100 km north of Kuala Lumpur, though quadrat survey was not carried out there. Genting Highlands seemed to be too developed as a mountain resort or recreation center to survive the species.

Table 5. List of plants found growing in quadrat (Myg-3) with *Spathoglottis aurea* in Genting Highlands

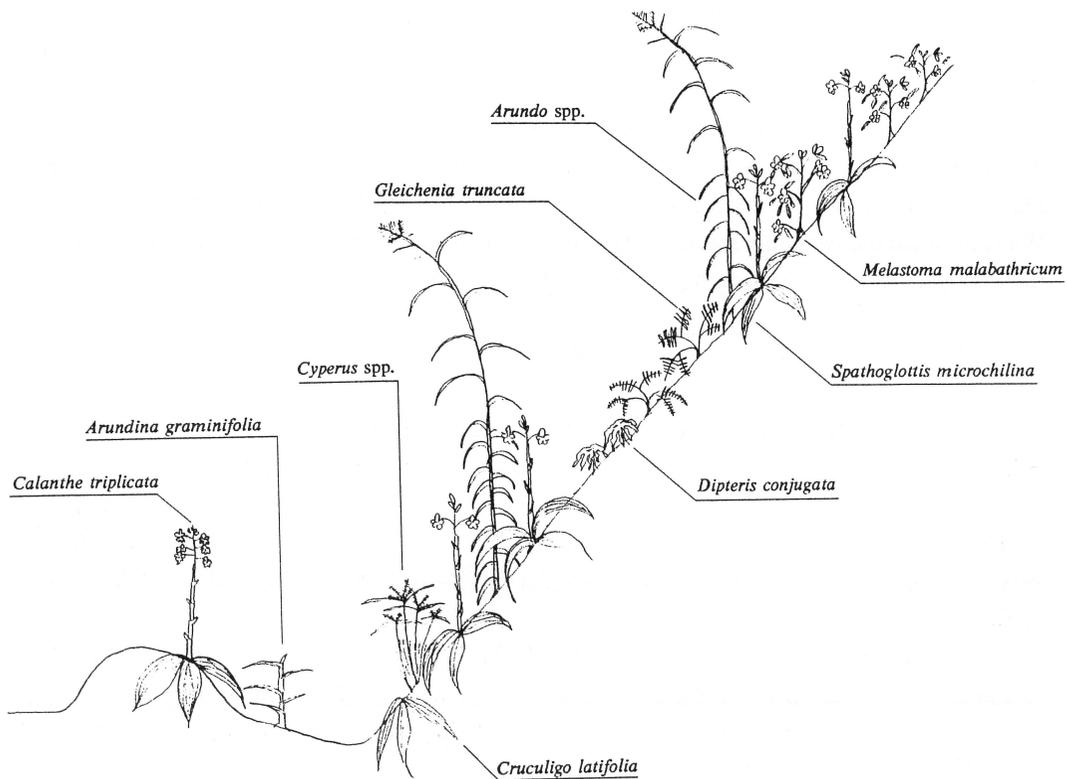
Scientific name	Japanese name	Coverage	No. of plants
Orchid			
<i>Spathoglottis aurea</i>	コウトウシランの仲間	1	
Herb			
<i>Dicranopteris linearis</i>	コシダの仲間	4	
<i>Cyperus</i> spp.	カヤツリグサの仲間	1	
Gramineae	イネ科	1	
<i>Solanum</i> spp.	ナスの仲間	1	
<i>Nepentes</i> spp.	ウツボカズラの仲間	1	3
<i>Sphenomeris chinensis</i>	ホラシノブ	1	
<i>Blechnum orientale</i>	ヒリュウシダ	1	

Fig. 5. Profile diagram of vegetation where *Spathoglottis aurea* was found in Genting Highlands (quadrat Myg-3).

*Spathoglottis microchilina* Kraenzl. was found in the quadrat, Myk-2 (1,570 m), in the island of Borneo, where the headquarters of Mt. Kinabalu is located near by. In this location, *S. microchilina* grew with two other terrestrial orchid species, *Arundina graminifolia* and *Calanthe triplicata*, as well as some ferns such as *Lycopodium complanata* and grasses such as *Cruculigo latifolia* (Table 6 and Fig. 6). The survey found that the habitat for *Spathoglottis* is very limited especially in the tropical forest like in Borneo although development processes such as road construction prepare new habitats for the

Table 6. List of plants found growing in quadrat (Myk-2) with *Spathoglottis microchilina* in Kinabalu

Scientific name	Japanese name	Coverage	No. of plants
<b>Orchid</b>			
<i>Spathoglottis microchilina</i>	コウトウシランの仲間	2	55
<i>Arundina graminifolia</i>	ナリヤランの仲間	1	5
<i>Calanthe triplicata</i>	ツルラン	1	6
<b>Shrub layer</b>			
<i>Melastoma malabathricum</i>	ノボタンの仲間	3	
<b>Herb</b>			
<i>Arundo</i> spp.	ダンチクの仲間	2	
<i>Alocasia odora</i>	クワズイモ	1	1
<i>Gleichenia truncata</i>	ウラジロの仲間	2	
<i>Cyperus</i> spp.	カヤツリグサの仲間	1	9
<i>Dipteris conjugata</i>	ヤブレガサウラボシ	1	2
<i>Cruculigo latifolia</i>	キンバイザサ	2	10
Gramineae	イネ科	2	
<i>Lycopodium complanata</i>	ヒカゲノカズラの仲間	1	

Fig. 6. Profile diagram of vegetation where *Spathoglottis microchilina* was found in Kinabalu (quadrat Myk-2).

*Spathoglottis*. However, the species seemed to be endangered by both weeding and competition with other plant species even though Mt. Kinabalu itself is well conserved from the horticultural collection.

Although certain climatic conditions of the Temperate Zone are somewhat similar to those of the corresponding elevation of the lower latitude, the climate of tropical highland is entirely different from that of subtropical lowland. In tropical highland, climatic conditions throughout the year are not very hot or very cold. Therefore, the plants from the tropical highlands are generally very difficult to survive as they are not tolerant to cold and heat conditions even similar to the winter or summer time of the Temperate Zone. These two *Spathoglottis* species are also said to be very difficult to grow in the tropical lowland.

The authors have been working on the breeding and *in vitro* propagation for a long time and realized that the micropropagation technique is also useful for the conservation of the wild orchid species. However, special attention must be made not to disturb the natural condition when the artificially propagated orchids are released (Tanaka and Mizutani 1995, 1996). Research in this aspect is needed not only to find the germplasms (Uesato *et al.* 1981) for the breeding of the ornamental orchid cultivars but at the same time formulate for the conservation of the wild orchid species.

### Summary

In Malaysia, *Spathoglottis plicata* Blume, *S. aurea* Lindl. and *S. microchilina* Kraenzl., were found growing in the open places with high light intensity generally on the slopes formed by road construction and excavation in the mountainous areas such as Genting Highlands. The number of *S. plicata* found seemed to be reduced by competition with other plant species as well as by road maintenance work in the mountainous resort.

In Iriomote Island, Japan, *S. plicata* was found to be a leading plant species in succession. Although human activities such as road construction prepare new habitats for *Spathoglottis* both in Malaysia and in Japan, the species is endangered by human collection due to horticultural interest. While in Malaysia, two other species of *Spathoglottis* with golden flowers were also found growing in the open places, but at elevation higher than 1,500 m above sea level.

### 摘 要

マレーシアでは *Spathoglottis plicata* だけでなく、*S. aurea* 及び *S. microchilina* の 2 種の自生も確認することができた。マレーシアにおいて *S. plicata* は一般的に言われているほど人里近くには存在せず、高原リゾート地 Genting Highlands へ向かう道路沿いの日当たりのよい斜面などに自生していた。しかし、*S. plicata* の個体数は除草される所では地上部が刈り取られ、生育が困難となり減少したり、除草をされない場所では他の植物との競合に負けて減少したりするものと思われた。西表島で観察された結果とあわせると遷移におけるパイオニア的な植物であるものと思われ、人為的な影響では、道路建設などの開発により分布を広げる一方、趣味家の採取による絶滅も危惧された。Genting Highlands で見られた *S. aurea* および Kinabalu 山の管理事務所周辺に自生していた *S. microchilina* は *S. plicata* の自生がある場所よりも標高の高い 1,500 m 以上の道路沿いに自生が見られた。

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