

## New or little known epiphyllous liverworts, XXV. Records of an old collection from Singapore.

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**Abstract:** Pócs, T. (2023): New or little known epiphyllous liverworts, xxv. Records of an old collection from Singapore. *Frahmia* 31:1-6.\*

70 years ago Prof. Van der Wijk (GRO) made a small epiphyllous collection on Bukit Timah hill, in a primary lowland rainforest reserve near the town center of Singapore. The material was sent by Dr. B.O. van Zanten to me for identification. In the epiphyllous collection 6 liverwort species were present of which two, *Cololejeunea perakensis* Tixier and *Leptolejeunea truncatifolia* Steph. proved to be new for the bryoflora of Singapore.

### 1. Introduction

Prof. Van der Wijk from Groningen University collected epiphyllous liverworts and lichens in the Bukit Timah Nature Reserve in 1952, when this primary lowland rainforest plot was not yet exposed to the present heavy air pollution. Therefore epiphylls were probably much more abundant in that time. Dr. Bernard Otto van Zanten from the same university was kind to send these specimens to me for identification. Bukit Timah is the highest point of Singapore with its 164 m altitude in the centre of the island (fig. 1). The hill is still covered by primary rainforest, the first Nature Reserve in Singapore, which was established on an area of 163 ha in 1883. The forest is dominated by Dipterocarpaceae, for example by *Shorea curtisii* Dyer ex King, a straight boled canopy tree, which can grow up to a height of 70 m. Other common upper canopy tree is *Parishia insignis* Hook.f. (Anacardiaceae) (<https://www.nparks.gov.sg> 2023).

The Singapore bryoflora is relatively well studied. The first comprehensive work including all previous records and the results of two weeks fieldwork done in 1998 by Dr. Aino Juslén, is well summarized in a detailed and annotated synopsis the bryoflora (Piippo et al. 2002). Its environmental conditions and the history of its bryological exploration are well described in the work, which aimed also to describe the changes in the diversity due to the intensive human impact through the rapid urbanization of the area. After that work Zhu et al. (2018) made some additions and an updated checklist, based on their own and previous

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collections. The second work finally enumerated 120 liverwort and hornwort species in 45 genera.

The specimens collected by Prof. Van der Wijk were found on five 20–25 cm long „evergreen” leaves covered by six species of liverworts, dominated by three *Leptolejeunea* species and accompanied in small amount three other Lejeuneaceae. *Cololejeunea perakensis* Tixier and *Leptolejeunea truncatifolia* Steph. proved to be new for the bryoflora of Singapore. Some other leaves were occupied only by lichens. Hitherto, only three species were reported from Bukit Timah reserve living on leaf surfaces, as *Plagiochila bantamensis* (Reinw. et al.) Dumort. (Piippo et al. 2002), *Cololejeunea ceratilobula* (P.C.Chen) R.M.Schust. and *Leptolejeunea epiphylla* (Mitt.) Steph. (Zhu et al. 2018). In general, at present this reserve is very poor in epiphytic bryophytes, most probably due to the air pollution generated by the many vehicles used in the town. Numerous previously observed species became extinct (Piippo et al. 2002). The same problem can be observed also in other tropical metropolitan areas.

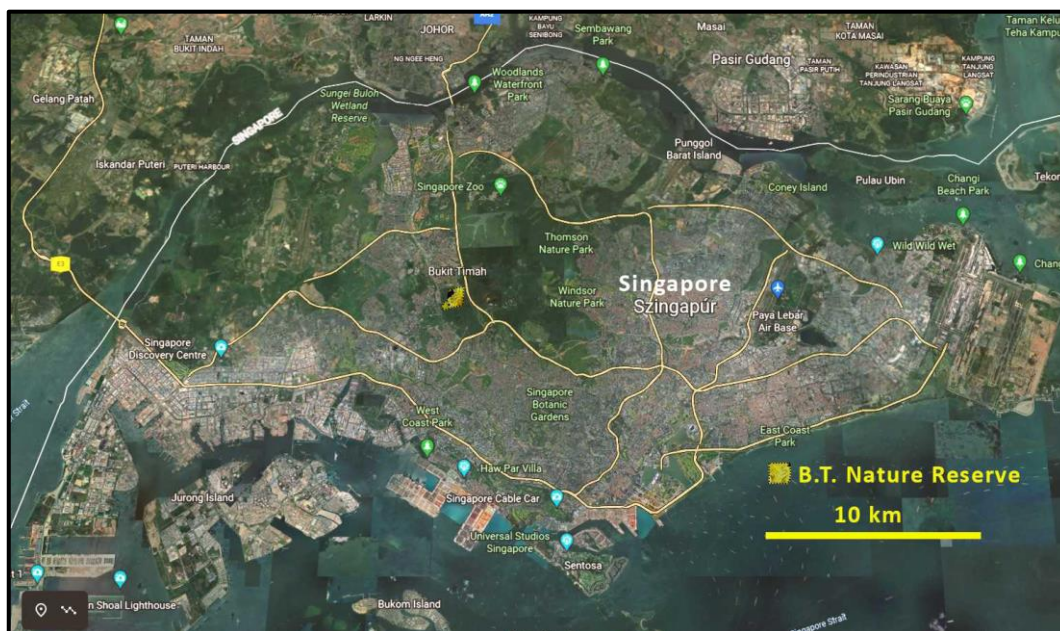


Fig. 1: The island state of Singapore with mark of the Bukit Timah Reserve

## 2. Results

Studying carefully the material collected in 1952, great abundance of epiphylls was experienced, with the absolute dominancy of three *Leptolejeunea* species, typical for the lowland rainforest areas. The other three species were represented only by a few (*Cheilolejeunea*) or one shoot only (in case of the two *Cololejeunea*). The specimens are deposited in the National herbarium of the Netherlands: Naturals Biodiversity Center (NL) and in the Herbarium of Eszterházy Catholic University in Eger (EGR). The following

enumeration is the full list of the epiphyllous bryophyte species collected by prof. Van der Wijk (Fig. 2) in the Bukit Timah Reserve and identified by me:

HERBARIUM GRONINGANUM-BRYOPHYTA		140	
Hepaticae	No 13971	Genus: <i>Physocolea</i>	
Fam.		Species:	
Exsic. R mal	140/74	Det.	
Insula Singapore Isl.			
Loc. Bukit Timah			
Hab. On humus, epiphyllous			
		Alt.	m.
Leg.	Vander Wijk	No 74	dd. 12 1952
Dupl. in Herb. L Vander Wijk			

Fig. 2: The herbarium label of the epiphylls collected by Prof. Van der Wijk

*Cheilolejeunea vittata* (Steph. ex G.Hoffm.) R.M.Schust. & Kachroo (Figs.3–4).

This species was seen also by Zhu et al. (2018) in 2007, between Nee Soon Stream and freshwater swamp. It is a Malesian species distributed from Java to New Guinea. Easily recognizable by the large group of median ocelli in its lobe, not sharply limited from the surrounding cells. First published from Singapore by Zhu et al. (2018), collected on decaying logs between Nee Son Stream and Swamp in 2007.

*Cololejeunea floccosa* (Lehm. & Lindenb.) Schiffn.

A very small species from subgenus *Taeniolejeunea* (Zwickel) Benedix, with unipapillose lobe cells. It has a vitta more than 4 cells long, made up from two rows of ocelli. Special character is that only one falcate lobule tooth developed. This feature is shared with a rare species occurring in China and Japan (*Cololejeunea subfloccosa* Mizut.). *Cololejeunea floccosa* is very variable, distributed all over the Palaeotropics.

*Cololejeunea perakensis* Tixier (Figs. 5–6).

A species of subgenus *Pedinolejeunea*. Its hyaline margin is narrow, one cell wide and does not reach the ventral margin of the lobe and often eroded. Specific and easily detectable

character the two erect, equally long, narrow, acute lobule teeth built up by 2(–3) uniseriate cells. It is a rare Indomalaysian species hitherto known only from the lowland rainforests of Sri Lanka and Peninsular Malaysia.

*Leptolejeunea epiphylla* (Mitt.) Steph. (Figs. 7–8).

Widespread Pantropical species well distinguished from other *Leptolejeunea*-s by the trapezoidal leaf shape, serial ocelli and by the usually reduced lobules. From Singapore first published by Zhu et al. (2018).

*Leptolejeunea maculata* (Mitt.) Schiffn.

A very widespread Palaeotropical species known from West-Africa to the Society Islands. Specific characters are the serrate or dentate lobe margin, the usually contracted lobe and the always large trigones and intermediate thickenings in the cell walls.

*Leptolejeunea truncatifolia* Steph. (Figs. 9–10).

A species recognizable by its oblong-ovate lobe with rounded to truncate apex and with cells without trigones. One (or rarely two) large basal ocelli are conspicuous but in dry material the scattered laminal ocelli hardly visible as they are almost or exactly the same size as the surrounding cells. This species is known only from the Philippines and from Taiwan (Zhu & So 2001) therefore new to the bryoflora of Singapore.

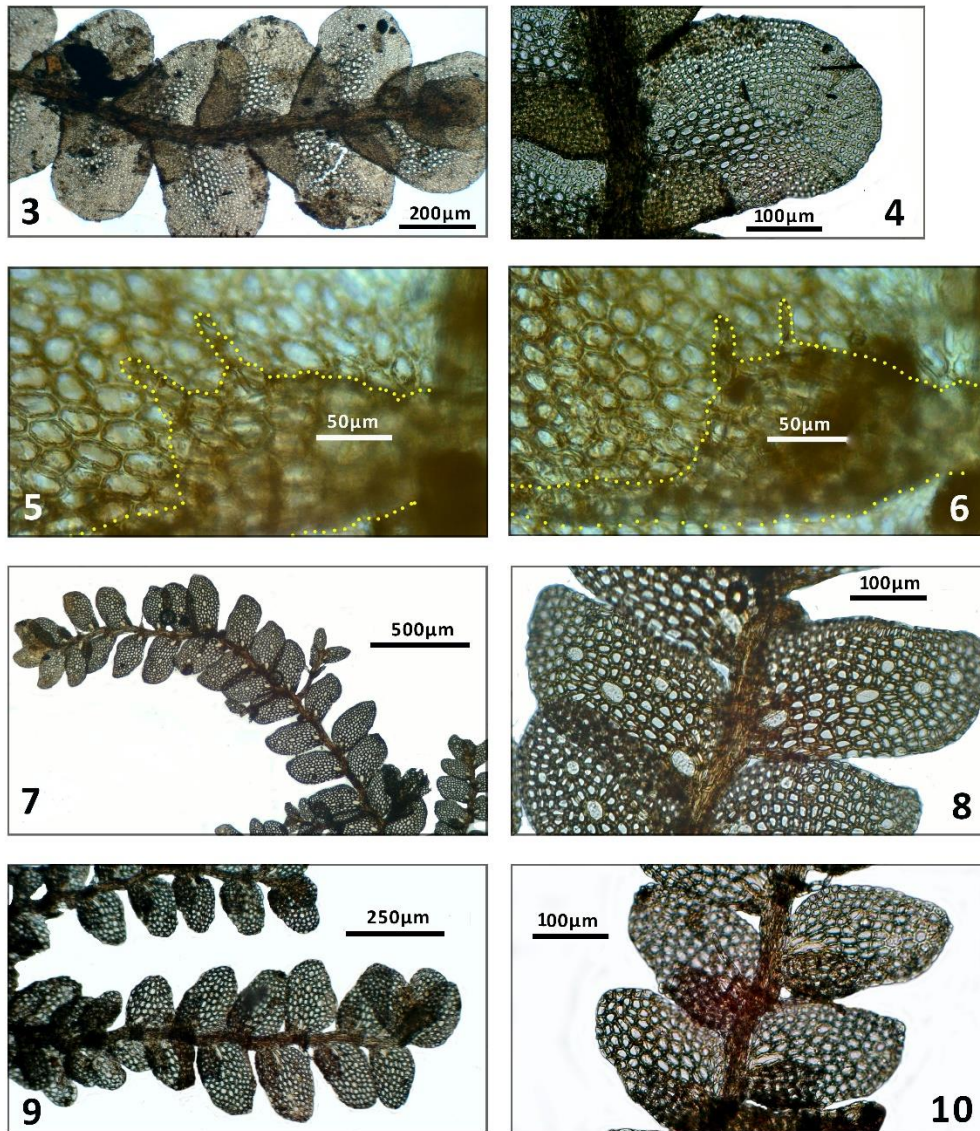
### 3. Discussion

The bryoflora of this small island state surely was more diverse in the time of colonization, when first a great part of the former lowland rainforest was converted into rubber plantations and later on the place became an important and very busy world commercial center with dense and continually increasing population. In the time of the epiphyllous sample collected prof. Van der Wijk, bryophytes had to be much more abundant in Bukit Timah Reserve too. The leaves he collected were fully covered by liverworts or lichens.

Juslén in 1998 could already see only very scanty epiphytic bryophytes on the bark of trees or on decaying logs in the Bukit Timah Reserve and supposed connections with heavy winds and air pollution effecting the area (in Piippo et al. 2002). I had the same experience visiting the area with the guidance of the late Dr. Benito Tan in 1999, not able to observe there any leaf inhabiting cryptogams. The reason is probably the increasing air pollution in Singapore, due to the use of many vehicles. Nowadays epiphylls on Bukit Timah occur only in well protected gullies, like the Fern Valley (Zhu et al. 2018) and at present epiphylls can survive in larger amount only near the sweetwater lakes and swamps, far from the town traffic. Therefore I suppose that the enumerated species at least partly, became already extinct.

I could witness the same decay of epiphytic cryptogams in Hanoi, the Vietnamese capital. There in 1963–65 I was able to collect a number of bryophytes from the bark of roadside and park trees even in the town centre, around the Hoan Kiêm lake or near to the Opera House and Hotel Metropol, as *Acrolejeunea sadvicensis* (Gottsche) Steph., *Hyophila involuta* (Hook.) Jaeg., *Venturiella perrottetii* (Mont.) Pursell (former *Aulacopilum luzonense* Bartr.), *Calymperes tenerum* Müll.Hal., *Erythrodontium julaceum* (Hook.) Par. and *Stereophyllum anceps* (Bosch & Lac.) Broth. (Pócs et al. 1967). Near 40 years later, in





**Figs 3 and 4:** The habit and leaf of *Cheilolejeunea vittata* (ventral view). **Figs 5 and 6:** The lobules with paired teeth of *Cololejeunea perakensis*. **Figs 7 and 8:** The habit and leaves of *Leptolejeunea epiphylla* (ventral view). **Figs 9 and 10:** The habit and leaves of *Leptolejeunea truncatifolia* (ventral view).

2002, revisiting the metropolis now with more than 8 million inhabitants, I could not find any bryophytes on the roadside trees. The reason obviously is, that while in mid last century all Hanoi people used bicycles, nowadays almost everyone rides a scooter or motorbike in an awful density on the streets, and also the passenger car and truck traffic increased, creating heavy air pollution.

Learning from these examples, in my opinion is very urgent to make biodiversity inventories in areas influenced by human activities (deforestation, new settlements, industrial activities creating air pollution, etc.). By the end of the XXI. Century. the extinction of environment sensitive living things, like epiphyllous liverworts will be at very high level, except for strictly protected national parks, reserves and inaccessible mountain habitats

#### 4. Acknowledgments

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