

## Epiphyllous liverworts on rosette leaves of *Ardisia* species (Myrsinaceae) in China

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**Abstract:** Four species of *Ardisia* (Myrsinaceae, Magnoliopsida) with rosette or low-lying leaves in China (including Hong Kong) have been found to be the hosts for 12 species of epiphyllous liverworts which belong to 4 families and 9 genera. However, no obvious species-specific host-epiphyte relationship could be recognized.

### Introduction

Epiphyllous liverworts manifest an interesting relationship with broad-leaved vascular plants. Found in tropical and subtropical regions where the habitats have a high relative humidity in the air and shaded areas with only diffuse light, these liverworts grow on the upper leaf surface of their hosts. The biodiversity and host-epiphyte relationship has attracted much attention, particularly in China (But & Gao, 1991; Chen & Wu, 1964; Gao & But, 1988; Li & Wu, 1988; Lin et al. 1982; Liu et al., 1988; Luo, 1990; Wu et al., 1983, 1987a, b; Wu & Guo, 1986; Wu & Lin, 1978, 1988, 1994; Wu & Luo, 1978; Zhu 1995). However, little scientific studies have been made on the microhabitats and the biological relationship between epiphyllous liverworts and their vascular hosts. But & Gao

(1991) have observed that the host leaves are often of two or more years old, flat, broad, or together they form a broad surface (e.g. *Selaginella*), smooth or hairy. Such leaves include those on stoloniferous and creeping species and thus lying close to the ground and also those growing on trees up to 2 m above the ground. Wu et al. (1987a, b) have compiled some preliminary observation on the diffuse light condition of the general environment of epiphyllous liverworts. Berrie & Eze (1975) have demonstrated that in *Radula flaccida*, a generally terrestrial liverwort but occasionally epiphytic on leaves, the water and P<sup>32</sup> nutrient could move from the host leaves to the liverwort. Thus, they concluded that epiphyllous *R. flaccida* is a semi-parasite rather than a simple epiphyte. The lack

of more detailed studies on the epiphyte-host relationship may possibly be caused by the difficulty in maintaining a convenient system for proper investigation. Recently, But (1997) reported that epiphyllous liverworts were found on the leaves of rosette-leaved angiosperms and suggested that the hosts and the epiphytes together could be transplanted to green houses or laboratories for controlled experimental studies.

Following this lead, we have further checked on various rosette-leaved angiosperms in the field and herbaria. In this report, we report on the liverworts found on host plants belonging to the angiosperm family Myrsinaceae.

Myrsinaceae is a family of dicotyledon plants distributed mainly in tropical regions (Hutchinson 1959). Majority of the genera and species in this family are trees or shrubs, but *Ardisia primulaefolia* Garn. et Champ. is sub-herbaceous and has a stunted stem with only rosette leaves lying flat on the ground. The leaves are obovate or oblong-obovate, 6–17 x 3–10 cm, somewhat succulent, densely gland-dotted and soft-hairy. It is widely distributed in southern China, including such provinces as Yunnan, Guangxi, Fujian, Hainan and Guangdong as well as Hong Kong, growing on the ground in hillside woodlands at altitudes between 500–1400 m. Very frequently, epiphyllous liverworts are found growing on the leaves of this plant, especially in woodland areas close to running water or fed by morning fogs. Another three species, *Ardisia mamillata* Hance, *A. pubivenula* Walker, and *A. villosa* Roxb., are not really rosette-like in leaf formation. They are, however, short shrubby or sub-herbaceous plants with low-lying stems bearing leaves that are close to the ground (Chen, 1979). Their leaves are also gland-dotted and stiff, or soft and hairy. Liverworts are found growing on their leaves. A total of 12 species of liverworts are identified on the leaves of these four species of *Ardisia* in China (List 1).

*Ardisia primulaefolia* is the more popular host plant for epiphyllous liverworts. So far, six epiphyllous liverworts, *Cheilolejeunea intertexta*, *Cololejeunea goebelii*, *C. spinosa*, *Leptolejeunea elliptica*, *Heteroscyphus argutus* and *Lopholejeunea subfusca*, are found on the leaves of *A. primulaefolia*. On the other hand,

*Cololejeunea goebelii* is the more widespread liverwort, found on the leaves of not only *Ardisia primulaefolia*, but also of *Ardisia mamillata* and *A. villosa*. No species-specific relationship, however, could be recognized. It may be of interest to note that leaves of the four species of *Ardisia* are densely hairy, bearing around 100 hairs per square centimeter. Therefore, the leafy stems of the 12 species of liverworts could only anchor on the hairless areas and spread their bodies in the 'forest' of hairs.

The four species of *Ardisia* are widely distributed in southern regions of China. They are short and small plants. Therefore, they can be easily transplanted to green houses and laboratories for controlled experimentation on the biological relationship between the hosts and epiphyllous liverworts. It would be interesting if further analysis on the presence of epiphyllous liverworts on these plants may suggest them to be indicators of specific ecological condition and degree of biodiversity. Moreover, since it is quite often for the angiosperm botanists to collect the whole plant of rosette-leaved species as a herbarium specimen, it would be convenient to simply check the preserved dried specimens in herbaria and determine the extent and diversity of their epiphyllous liverworts that can suggest the ecological conditions in the various collection localities.

List 1. A list of the epiphyllous liverworts on the leaves of Myrsinaceae

Herbertaceae

1. *Herberta adunca* (Dicks.) S. Gray  
Yunnan: Deqin Co., on leaves of *Ardisia pubivenula*, 2,700–3,200 m alt., (collector anonymous 5576).

Lepidoziaceae

2. *Bazzania tridens* (Reinw., Blume et Nees) Trev.  
Hainan: Mt. Wu Zhi, on leaves of *Ardisia mamillata* (F.A. McClure & E. D. Merrill 9333).

Lophocoleaceae

3. *Heteroscyphus argutus* (Reinw., Blume et Nees) Schiffner  
Guangdong: Liang Co., Mt. Tianguang, on leaves of *Ardisia primulaefolia*, 800 m alt. (P-X. Tan 60201a).

## Lejeuneaceae

4. *Lopholejeunea subfusca* (Nees) Stephani  
Hong Kong: Mt. Parker, on leaves of  
*Ardisia primulaefolia* (S.-Y. Hu 9256).

5. *Drepanolejeunea dactylophora* (Nees)  
Spruce

Hainan: Baoting Co., on leaves of *Ardisia  
pubivenula* (K.-Z. Hou 73665b).

6. *Drepanolejeunea thwaitesiana* (Mitten)  
Stephani

Hainan: Baoting Co., on leaves of *Ardisia  
pubivenula* (K.-Z. Hou 73665a).

7. *Cheilolejeunea intertexta* (Lindenberg)  
Stephani

Hong Kong: Tai Mo Shan, on leaves of  
*Ardisia primulaefolia* (S.-Y. Hu 6121b).

8. *Leptolejeunea elliptica* (Lehmann et Linden-  
berg) Schiffner

Fujian: Nanqing, Mt. Xinluo, on leaves of  
*Ardisia primulaefolia*, 510 m alt. (Amoy  
University 618).

9. *Lejeunea ulicina* (Tayl.) Gottsche  
Yunnan: Mar-Li-Po, on leaves of *Ardisia  
primulaefolia*, ca. 1000 m alt. (P.-X. Tan  
60201).

10. *Cololejeunea goebelii* (Schiffner) Schiffner  
Hainan: Mt. Wuzhi, on leaves of *Ardisia  
villosa* (F.A. McClure et E.D. Merrill  
8671). Guangdong: Mt. Lofau, on leaves  
of *Ardisia mamillata* (C. Ford without  
number); Liang Co., near Wangjunding, on  
leaves of *Ardisia primulaefolia* (P.-X. Tan  
58551b). Guangxi: Lang Co., on leaves of  
*Ardisia primulaefolia*, ca 400 m alt. (R.-C.  
Ching 5664). Fujian: Liancheng Co., on  
leaves of *Ardisia primulaefolia* (R. Lin  
3824). Hong Kong: Pokfulam, on leaves  
of *Ardisia primulaefolia* (H.-C. Tang 430);  
Mt. Gough, on leaves of *Ardisia  
primulaefolia* (H.-C. Tang 1486); Findley  
Rd., on leaves of *Ardisia primulaefolia* (H.-  
C. Tang 1188).

11. *Cololejeunea spinosa* (Horikawa) Pande et  
Misra

Hainan: Wengyuan Co., Mt. Bijia, on  
leaves of *Ardisia primulaefolia* (X.-X. Liu  
25270b). Yunnan: Mar-Li-Po, on leaves of  
*Ardisia primulaefolia*, 1,000 m alt. (C.-W.  
Wang 86842a). Guangdong: Liang Co.,  
Mt. Tianguang, on leaves of *Ardisia*

*primulaefolia*, 800 m alt. (P.-X. Tan  
60201b); Liang Co., near Wangjunding, on  
leaves of *Ardisia primulaefolia*, 700 m alt.  
(P.-X. Tan 58551a).

12. *Cololejeunea reineckeana* Stephani  
Hainan: Wengyuan Co., Mt. Bijia, on  
leaves of *Ardisia primulaefolia* (X.-X. Liu  
25270a).

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## Literature Cited

- Berrie GK, Eze J.M.O. 1975.** The relationship  
between an epiphyllous liverwort and host leaves.  
*Annales of Botany* 39: 955-963.
- But P.P.H. 1997.** Relationship between epiphyllous  
liverworts and their hosts. 1. Epiphyllous  
liverworts and *Ardisia primulaefolia*  
(Myrsinaceae). *Abstracts, International  
Association of Bryologists Symposium on 2000's  
Bryology*, May 26-30, 1997, Beijing, China, p. 37.
- But P.P.H., Gao C.-H. 1991.** Epiphyllous hepaticae  
of Kowloon Peninsula (Hong Kong). *Tropical  
Bryology* 4: 17-22.
- Chen, C. 1979.** Myrsinaceae. In: *Flora Republicae  
Popularis Sinicae* 58:1-133.
- Chen P.-C, Wu P.-C. 1964.** Study on epiphyllous  
liverworts of China (I). *Acta Phytotaxonomica  
Sinica* 9: 213-256.
- Gao C.-H, But P.P.H. 1988.** Epiphyllous liverworts  
of Daiwu Shan, Jiulong (Kowloon). *Acta Botanica  
Yunnanica* 10: 253-256.
- Hutchinson J. 1959.** The Families of Flowering  
Plants. Vol. I: Dicotyledons pp. 345-346. Oxford,  
Clarendon Press.
- Li D.-K., Wu P.-C. 1988.** A study of the epiphyllous  
liverworts of China (IV). The epiphyllous  
liverworts on Jinggang Shan, Jiangxi Province.  
*Investigatio et Studium Naturae* 8: 38-42.
- Lin P.-J., Yang Y.-Y., Li Z.-H. 1982.** A study on  
the bryophytes of Ding Hu Shan. *Tropical and  
Subtropical Forest Ecosystems* 1: 58-76.
- Liu Z.-L., Guo X.-H., Hu R.-L. 1988.** Investigation  
on the epiphyllous liverworts from southern parts  
of Anhui Prov., East China. *Journal of East China  
Normal University (Natural Science)* 4: 89-96.
- Luo J.-S. 1990.** A synopsis of Chinese epiphyllous  
liverworts. *Tropical Bryology* 2: 161-166.
- Wu P.-C., Guo X.-H. 1986.** A report on the

- epiphyllous liverworts in Anhui Province, China. *Acta Phytotaxonomica Sinica* 24: 136-138.
- Wu P.-C., Li D.-K., Gao C.-H. 1983.** Studies on the epiphyllous liverworts of China (III) - the epiphyllous liverworts on Wuyi Mt., Fujian Province. *Wuyi Science Journal* 3: 1-6.
- Wu P.-C., Li D.-K., Gao C.-H. 1987a.** Preliminary measurement on some ecological factors of the epiphyllous liverworts in Mt. Wuyi. *Acta Botanica Sinica* 29(4): 449-452.
- Wu P.-C., Li D.-K., Gao C.-H. 1987b.** Light and epiphyllous liverworts in the subtropical evergreen forests of South East China. *Symposia Biologica Hungarica* 35: 27-32.
- Wu P.-C. and Lin P.-J. 1978.** A preliminary observation on the Hepaticae of Hainan Island, China and their phytogeographical relationships. *Acta Phytotaxonomica Sinica* 16(2): 56-71.
- Wu P.-C. and Lin P.-J. 1994.** Studies on the epiphyllous liverworts of China (VI). The epiphyllous liverworts of Hainan Island. *Chenia* 2: 115-120.
- Wu P.-C. and Lin Q.-W. 1988.** The epiphyllous liverworts in Maolan, Libo County, SW China. *Guihaia* 8: 335-338.
- Wu P.-C. and Luo J.-S. 1978.** Study on the epiphyllous liverworts of China (II) - the epiphyllous liverworts from Tibet. *Acta Phytotaxonomica Sinica* 16(4): 102-112.
- Zhu R.-L. 1995.** Notes on some species of the genus *Cololejeunea* (Lejeuneaceae, Hepaticae) in China. *Journal of the Hattori Botanical Laboratory* 78: 83-109.