

中国桂林岩溶洞穴苔藓植物研究

张朝晖, 赵传海, 李晓娜, 彭涛, 黄文琥, 姜洪

(贵州师范大学地理与生物科学学院, 贵州贵阳 550001)

摘要: 对采自中国广西桂林 17 个岩溶洞穴的 192 份苔藓植物标本进行研究, 报道了洞穴苔藓 13 科 19 属 28 种, 其中含广西苔藓植物新记录 16 种。野外观察表明, 桂林岩溶洞穴苔藓植物主要分布于洞穴洞口 0~32 m 弱光带范围内。三种丛集型藓类植物: 净口藓、钩喙净口藓和东亚泽藓参与岩溶洞穴洞口带钙华沉积。

关键词: 苔藓植物; 区系; 钙华; 岩溶; 洞穴; 桂林

中图分类号: Q948.15 **文献标识码:** A **文章编号:** 1000-3142(2005)02-0107-05

Bryophytes of Karst caves in Guilin area, China

ZHANG Zhao-hui, ZHAO Chuan-hai, LI Xiao-na,
PENG Tao, HUANG Wen-hu, JIANG Hong

(School of Geography and Biology, Guizhou Normal University, Guiyang 550001, China)

Abstract: 192 bryophyte specimens were collected from 17 caves in the Guilin Karst area, Guangxi, China. 28 species in 18 genera and 13 families were listed with site, substrate, altitude, date, collectors. Among them, 16 taxa are new records for Guangxi Autonomous Region. The fieldwork indicated the bryophytes grew within 0~32 m. distance with weak light from the cave entrance. Three turf species, including *Gymnostomum calcar-eum* Nees et Horsch., *G. recurvirostre* Hedw. and *Philonotis turneriana* (Schwaegr.) Mitt. were associated with cave travertine deposition at thresholds.

Key words: bryophytes; flora; travertine; Karst; cave; Guilin

1 Introduction

Guilin Karst area is situated between 110°9'E ~110°42'E; 24°40'N~25°40'N, Guangxi Autonomous Region, China, including Guilin City, Yangshou County and Lipu County. The total land area is 7 420 km², altitude ranges from 150 m to 1 936 m above sea level. The Guilin Karst area belongs to subtropical zone, with an average annual temperature of 19.1 °C and annual precipitation about

1 296 mm (Zhu *et al.*, 1988). Geologically, Guilin contains one of the most beautiful and famous Karst areas in China, with carbonate rock covering an area of about 3 464.6 km². The strata are composed of various types of rocks such as micritic limestone, biogenetic limestone and dolomite, its thickness may reach 2 500~4 000 m. According to statistics, there are more than 2000 Karst caves of considerable size in the studied area (Zhu *et al.*, 1988).

From 1993 to 2001, a series of bryological expe-

收稿日期: 2004-02-12 修订日期: 2004-07-12

基金项目: 国家自然科学基金(39960009); 教育部优秀青年教师资助计划(教人司(2002)40); 国家人事部留学人员择优资助项目(国人部发(2003)50号); 贵州省优秀科技教育人才省长专项基金(黔科教(2003)04)资助项目部分成果。

作者简介: 张朝晖(1962), 男, 贵州赫章县人, 教授, 主要从事苔藓植物学、岩溶植物生物学和生物多样性科学研究。

ditions were conducted by Guizhou Normal University in the Karst area of Guizhou, Sichuan and Guangxi (Zhang, 1993, 1996; Zhang *et al.*, 1996; Zhang *et al.*, 1997; Wang *et al.*, 2002). In 1998 and 2001, 17 Karst caves in the Guilin area were investigated in detail in our fieldwork research (Table 1), including Guilin City (11 caves), Lipu County (3 caves), Yangshuo County (5 caves). According to cave rock type, Two cave types can be distinguished namely: limestone caves and dolomite caves.

2 Results

A total of 192 bryophyte specimens were collected. We were able to identify 28 species in 18 genera and 13 families (Table 2). Compared with earlier publications in Guangxi Province by bryologists and botanists (Wang *et al.*, 2002; Piippo, 1990; Wang, 1993; Redfearn *et al.*, 1996; Du, 1997; Zhu *et al.*, 2003), 16 taxa are new records for Guangxi Autonomous Region.

Table 1 Karst caves investigated in Guilin Karst area

City & County	Cave name	Cave rock	Travertine	Altitude(m)	Species number	Investigated date
Guilin City	1. Yujashan Cave	Limestone	No	185	4	9.8, 1998
	2. Yujashan Cross-Cave	Limestone	Seepage	218	1	9.8, 1998
	3. Yujashan Cliff-Cave	Limestone	Stalagmite	195	4	9.8, 1998
	4. Putoshan Cave	Limestone	No	190	1	9.8, 1998
	5. Yinshan Cave	Limestone	No	248	2	10.8, 1998
	6. Qixing Cave	Limestone	Dry stalagmite	235	6	17.8, 2001
	7. Lement Wind Cave	Limestone	No	190	5	17.8, 2001
	8. Shanmingkon Cave	Limestone	No	195	2	15.8, 2001
	9. Moon Cave	Limestone	No	185	4	15.8, 2001
Lipu County	10. Zhuang Sister Cave	Dolomite	Seepage	215	6	16.8, 2001
	11. Xiaoyao Cave	Limestone	Seepage	215	8	16.8, 2001
	12. Fengyu Cave	Limestone	No	264	5	16.8, 2001
Yangshuo County	13. Bilian Cave	Limestone	No	195	4	16.8, 2001
	14. Chenboshan 1	Limestone	No	190	3	16.8, 2001
	15. Chenboshan 2	Limestone	No	195	2	16.8, 2001
	16. Chenboshan 3	Limestone	No	235	4	16.8, 2001
	17. Chenboshan 4	Dolomite	No	235	2	16.8, 2001

In the fieldwork, we observed that bryophytes occur only within 0~32 m distance with weak light from the cave entrance. Three turf species, including *Gymnostomum calcareum* Nees et Horsch., *G. recurvirostre* Hedw. and *Philonotis turneriana* (Schwaegr.) Mitt., were associated with cave travertine deposition such as stalagmite, stalactite and seepage at the cave threshold.

The genus *Cyathodium* are often growing in Karst area, which occurs mainly at cave entrance of limestone & dolomite caves in tropical or subtropical Karst areas. In China it was Professor Xu Wenxian (1964) who recorded firstly the population of *Cyathodium cavernarum* Kunze at the entrance of some limestone caves in Kunming area in Yun-

nan Province in 1964, later more sites recorded from Yunnan, Sichuan and Guizhou Province in China by other bryologists (Hu, 1987; Gao, 2000; Zhang, 1996, 2002; Wang *et al.*, 1996). However, there are no information about *Cyathodium* in Guangxi Province. It was interesting that *Cyathodium cavernarum* Kunze were found in 2 caves while *C. smaragdium* Schiffin ex Keissler in 8 caves in the Guilin Karst area. Both species thalli with the luminous and green light at dark caves, *C. cavernarum* was found within 1~12 m at cave entrance while *C. smaragdium* within 0.5~22 m.

The list of bryophytes in Karst caves from Guilin Karst area is presented here. Species are arranged alphabetically, followed by the cave name,

Table 2 Bryophytes in the caves of Guilin Karst area, China

Family name	Genus name	Species name	Distribution cave
Radulaceae	<i>Radula</i>	<i>R. japonica</i> Gott. ex Steph.	14
Calypogeiaceae	<i>Calypogeia</i>	<i>C. arguta</i> Nees et Mont.	7
Cyathodiaceae	<i>Cyathodium</i>	<i>C. cavernarum</i> Kunze	10, 11
		<i>C. smaragdium</i> Schiffin ex Keissler	1, 4, 6, 7, 13, 15, 16
Marchantiaceae	<i>Marchantia</i>	<i>M. papillata</i> Raddi subsp. <i>grossibarba</i> (Steph.) Bischl.	9, 10, 13
Fissidentaceae	<i>Fissidens</i>	<i>F. areolatus</i> Griff.	11
		<i>F. gymnogynum</i> Besh.	12, 17
		<i>F. obscurus</i> Mitt.	10, 8
		<i>F. plagiochloides</i> Besch.	9, 16
		<i>F. taxifolius</i> Hedw.	6, 15, 7
		<i>F. tosaensis</i> Broth.	8, 9
Pottiaceae	<i>Gymnostomum</i>	<i>G. calcareum</i> Nees et Hornsch.	2, 9
		<i>G. recurvirostre</i> Hedw.	10, 13
	<i>Tortella</i>	<i>T. tortuosa</i> (Hedw.) Limp.	11
	<i>Tortula</i>	<i>T. schmidii</i> (C. Muell.) Broth.	1, 10, 11
		<i>T. yunnanensis</i> Chen	10
	<i>Timmiella</i>	<i>T. anomala</i> (B. S. G.) Limpr.	7
	<i>Weisia</i>	<i>W. planifolia</i> Dix.	11
Mniaceae	<i>Plagiomnium</i>	<i>P. cuspidatum</i> (Hedw.) T. Kop.	6
Bartramiaceae	<i>Philonotis</i>	<i>P. turneriana</i> (Schwaegr.) Mitt.	3
Racopilaceae	<i>Racopilum</i>	<i>R. aristaum</i> Mitt.	12
Daltoniaceae	<i>Cyathophorella</i>	<i>C. tonkinensis</i> (Broth. et Par.) Broth.	14
Entodontaceae	<i>Entodon</i>	<i>E. angustifolium</i> (Hedw.) C. Muell.	1
		<i>E. viridulus</i> Cord.	11
Thuidiaceae	<i>Anomodon</i>	<i>A. thraustus</i> C. Muell.	14
	<i>Claopodium</i>	<i>C. rugulosifolium</i> Zeng.	1, 6, 12
Hypnaceae	<i>Taxiphyllum</i>	<i>T. taxirameum</i> (Mitt) Fleisch.	1, 6, 7, 9, 11, 12, 16, 17
	<i>Vesicularia</i>	<i>V. reticulata</i> (Doz. et Molk.) Broth.	6, 12

substrate, bryophyte within cave (m), altitude, date, collectors and collected number. One asterisk (*) before species name indicate new records for Guangxi Province. Two asterisk (**) after species name make cave travertine deposits. All specimens are deposited at School of Geography and Biology, Guizhou Normal University.

3 List of bryophytes in Karst caves from Guilin Karst area

3.1 Liverworts

Calypogeia arguta Nees et Mont. Lement Wind Cave, floor soil, 3 m. within, alt. 190 m, No. 01081705.

* *Cyathodium cavernarum* Kunze. Zhuang Sister Cave, dolomite soil, 8 m within, alt. 215 m,

No. 01081615. Xiaoyao Cave, wet limestone, 12 m within, alt. 215 m, No. 01081616.

* *C. smaragdium* Schiffin ex Keissler. Yujashan Cave, floor soil, 1~6 m within, alt. 235 m, No. 01081703. No. 01081702. Bilian Cave, limestone soil, 8 m within, alt. 195 m, No. 01081610; Chenboshan Cave 2, wet limestone soil, 0.5~1 m within, alt. 195 m, No. 01081607. Chenboshan Cave 3, limestone underforest, 2 m within, alt. 235 m, No. 01081604. Qixing Cave, dry stalagmite, dry travertine or limestone soil, 11 m within, alt. 235 m, No. 01081610, No. 01081608, No. 01081609. Lement Wind Cave, floor soil, 3~6 m within, alt. 190 m, No. 01081705. Yujashan Cave, soil, 1~2 m within, alt. 185 m, No. 099881; Putoshan Cave, limestone, 2~4 m within, alt. 190 m, No. 099885.

* *Marchantia papillata* Raddi subsp. *grossi-*

barba (Steph.) Bischl. Zhuang Sister Cave, dolomite soil, 8 m within, alt. 215 m, No. 01081613. Bilian Cave, limestone soil, 5~6 m within, alt. 195 m, No. 01081610, No. 01081611. Moon Cave, limestone, 1 m within, alt. 185 m, No. 01081505.

* *Radula japonica* Gott. ex Steph. Chenboshan Cave, limestone soil, 1.2 m within, alt. 190 m, No. 01081609.

3.2 Mosses

* *Anomodon thraustus* C. Muell. Chenboshan Cave, limestone soil, 0.5 m within, alt. 190 m, No. 01081609.

Claopodium rugulosifolium Zeng. Fengyu Cave, limestone, 3~5 m within, alt. 264 m, No. 01081622, No. 01081624. Qixing Cave, dry travertine, 12 m within, alt. 235 m, No. 01081609. Yujashan Cave, floor soil, 1~6 m within, alt. 235 m, No. 01081702.

* *Cyathophorella tonkinensis* (Broth. Et Par.) Broth. Chenboshan Cave, limestone soil, 1.2 m within, alt. 190 m, No. 01081608.

Entodon angustifolium (Hedw.) C. Muell. Yujashan Cave, soil floor 1~2 m within, alt. 185 m, No. 099881.

* *E. viridulus* Cord. Xiaoyao Cave, wet limestone, 5 m within, alt. 215 m, No. 01081620.

* *Fissidens areolatus* Griff. Xiaoyao Cave, wet limestone, 12~13 m within, alt. 215 m, No. 01081616, No. 01081617.

F. gymnogynum Besh. Fengyu Cave, limestone, 3 m within, alt. 264 m, No. 01081622. Chenboshan Cave 4, dolomite under forest, 1 m within, alt. 225 m, No. 01081602.

* *F. obscurus* Mitt. Zhuang Sister Cave, dolomite soil, 8 m within, alt. 215 m, No. 01081613. Shanmingkon Cave, limestone soil, 1~2 m within, alt. 195 m, No. 01081502.

* *F. plagiochloides* Besch. Chenboshan Cave 3, limestone under forest, 2 m within, alt. 235 m, No. 01081603. Moon Cave, limestone, 1~6 m within, alt. 185 m, No. 01081505, No. 01081504.

F. taxifolius Hedw. Bilian Cave, limestone soil, 6 m within, alt. 195 m, No. 01081610. Chen-

baoshan Cave 2, wet limestone soil, 1 m within, alt. 195 m, No. 01081608. Qixing Cave, dry travertine, 12 m within, alt. 235 m, No. 01081609. Lement Wind Cave, floor soil, 3 m within, alt. 190 m, No. 01081705.

* *F. tosaensis* Broth. Shanmingkon Cave, limestone soil, 2 m within, alt. 195 m, No. 01081502. Moon Cave, limestone, 6 m within, alt. 185 m, No. 01081504.

Gymnostomum calcareum Nees et Horsch. ** Yujashan Cross Cave, travertine seepage, 1 m within, alt. 218 m, No. 099882. ** Xiaoyao Cave, wet limestone, 1 m within, alt. 215 m, No. 01081620.

* *G. recurvirostre* Hedw. ** Zhuang Sister Cave, travertine, 1.5 m within, alt. 215 m, No. 01081614. Chenboshan Cave 3, dry travertine, 1.2 m within, alt. 235 m, No. 01081605, No. 01081606.

* *Philonotis turneriana* (Schwaegr.) Mitt. ** Yujashan Cliff Cave, stalagmite, threshold, alt. 195 m, No. 099884.

Plagiomnium cuspidatum (Hedw.) T. Kop. Qixing Cave, limestone, 32 m within, alt. 235 m, No. 01081607.

Racopilum aristaum Mitt. Fengyu Cave, wet limestone, 4 m within, alt. 264 m, No. 01081621.

Taxiphyllum taxirameum (Mitt.) Fleisch. Xiaoyao Cave, wet limestone, 12~13 m within, alt. 215 m, No. 01081616, No. 01081617. Fengyu Cave, limestone, 3 m within, alt. 264 m, No. 01081622. No. 01081623. Chenboshan Cave 3, limestone under forest, 2 m within, alt. 235 m, No. 01081606. Chenboshan Cave 4, dolomite under forest, 1~2 m within, alt. 225 m, No. 01081602, No. 01081601. Qixing Cave, limestone, 32 m within, alt. 235 m, No. 01081607. Yujashan Cave, floor soil, 1 m within, alt. 235 m, No. 01081701. Lement Wind Cave, limestone soil, 6 m within, alt. 190 m, No. 01081704. Moon Cave, limestone, 4 m within, alt. 185 m, No. 01081503.

* *Timmiella anomala* (B. S. G.) Limpr. Lement Wind Cave, floor soil, 3 m within, alt. 190 m, No. 01081705.

Tortella tortuosa (Hedw.) Limp. Xiaoyao Ca-

ve, limestone, 12 m within, alt. 215 m, No. 01081618. *Tortula schmidii* (C. Muell) Broth. Yinsan Cave, limestone soil, 1 m within, alt. 240 m, No. 099891. Zhuang Sister Cave, soil, 8 m within, alt. 215 m, No. 01081615. Xiaoyao Cave, wet limestone, 5 m within, alt. 215 m, No. 01081620.

* *T. yunnanensis* Chen. Zhuang Sister Cave, dolomite soil, 8 m within, alt. 215 m, No. 01081613.

* *Vesicularia reticulata* (Doz. Et Molk.) Broth. Fengyu Cave, wet limestone, 4 m within, alt. 264 m, No. 01081621. Qixing Cave, limestone, 32 m within, alt. 235 m, No. 01081607.

Weisia planifolia Dix. Xiaoyao Cave, wet limestone, 12 m within, alt. 215 m, No. 01081616.

4 Acknowledgements

I am grateful to many students of Guizhou Normal University for their assistance during our field expeditions and laboratory research. Thanks Professor Zhong Bengu & Professor Jiang Souzhong (Guizhou Normal University) for invaluable advice and criticism; Professor Li Xinjing (Kunming Institute of Botany, Chinese Academy of Sciences) for some Pottiaceae species identification. For fieldwork financial support provided by NSFC, TRAPOYT, SFDOCS and GFOSTE.

Reference:

- Du ZX. 1997. A study of medicinal bryophytes used in Guangxi Provinces, S China [J]. *Chenia*, 3—4, 123—124.
- Gao C, Cao T, et al. 2000. Cyathodiaceae. In: Flora Yunnan: Tomus 17 (Bryophyta, Hepaticae and Anthocerotae) [M]. Science Press, 563—565.
- Hu RL. 1987. Cyathodiaceae. In: Bryology [M]. Higher Education Press, 127—128.
- Piippo S. 1990. Annotated catalogue of Chinese Hepaticae and Anthocerotae [J]. *J Hattori Bot Lab*, 68: 1—192.
- Redfearn PL, Tan BC, He S. 1996. A newly updated and annotated checklist of Chinese mosses [J]. *J Hattori Bot Lab*, 79: 163—357.
- Wang MZ. 1993. A preliminary study of Hepaticae from Mt. Jiawan of Guangxi, South China [J]. *Chenia*, 1: 125—132.
- Wang ZH & Zhang ZH. 1996. Flora and ecological distribution of Liverworts in Huangguoshu Area [J]. *J Guizhou Normal Univ*, 14(1): 17—21.
- Wang ZH, Zhang ZH. 2002. Notes on the bryophytes of the Karst caves in Guangxi Province [J]. *Chenia*, 7: 95—99.
- Xu WX. 1964. A preliminary study on discovery of *Cyathodium aureo-nitens* (Griff.) Schin in China [J]. *Proceedings of the University of Yunnan*, 4: 19—24.
- Zhang ZH. 1993. The moss communities in Karst caves of Maolan, Lipo County, Guizhou Province [J]. *Chenia*, 1: 51—56.
- Zhang ZH. 1996. Contributions to the bryoflora of Guizhou, S. W. China; new records and habitat notes on mosses from Huangguoshu Karst Area [J]. *J Bryology*, 19: 149—152.
- Zhang ZH, Wang ZH, Zhu A. 1996. A preliminary study on bryokarst of caves in Huangguoshu Area [J]. *Carsologica Sin*, 15: 224—232.
- Zhang ZH, Wang ZH, Ran JC, et al. 1997. A preliminary survey of the bryophytes from three Black Leaf Monkey's Natural Reserves in Guizhou and Guangxi Province, SW China [J]. *Guihaia*, 17: 331—337.
- Zhang ZH, Wang ZH. 2002. A study on the bryophytes at Flying—Dragon cave of Guizhou [J]. *Chenia*, 7: 91—94.
- Zhu XU, Wang XY, Zhu DH, et al. 1988. Study on Karst Geomorphology and Caves in Guilin [M]. Beijing: Geological Publishing House.
- Zhu RL, So ML. 2003. Liverworts and hornworts of Shangsi County of Guangxi Province of China [J]. *Cryptogamic Bryologie*, 24: 319—334.