

深圳市中国科学院仙湖植物园

Fairylake Botanical Garden, Shenzhen & Chinese Academy of Sciences

# 蕨类植物图谱

## ——孢子体和原叶体

ALBUM OF PTERIDOPHYTES —— Sporophyte & Prothallus

焦瑜 王晖 张寿洲 著

Yu Jiao Hui Wang Shou-Zhou Zhang



中国林业出版社

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图书在版编目 (CIP) 数据

蕨类植物图谱：孢子体和原叶体：汉英对照 / 焦瑜，王晖，张寿洲  
著. — 北京：中国林业出版社，2013.1

ISBN 978-7-5038-6923-5

I. ①蕨… II. ①焦… ②王… ③张… III. ①蕨类植物—孢子体—图谱 ②蕨类植物—配子体—图谱 IV. Q949.36-64

中国版本图书馆CIP数据核字 (2013) 第008866号

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蕨类植物图谱——孢子体和原叶体

策划编辑：温晋

责任编辑：田红 温晋

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出版：中国林业出版社 (100009 北京西城区德内大街刘海胡同7号)

Email: wildlife\_cfph@163.com

电话：(010) 83225764

制版：北京美光设计制版有限公司

印刷：北京华联印刷有限公司

版次：2014年5月第1版

印次：2014年5月第1次

开本：889mm × 1194mm 1/32

印张：16

字数：512千字

定价：198.00元



献给深圳市仙湖植物园  
成立30周年

## 内容简介

蕨类在植物界系统演化中是一个独特的自然类群，生活史中存在可独立生活的原叶体世代和孢子体世代。原叶体是完成蕨类植物生活史的关键，在形体结构上与孢子体有明显差异。本书收集了来自中国热带和亚热带地区以及东南亚、澳大利亚和马来西亚的蕨类植物454种，2000余幅彩色图片和简练的中英文说明，直观展示了蕨类植物孢子体、成熟原叶体和部分幼孢子体形态特征的重要信息。可供植物学、繁殖生物学等领域的研究人员和生产技术人员借鉴，同时也适用于高等院校相关学科的师生参考。

## Brief Introduction

Pteridophyte (Lycophytes and Ferns) is a unique group in plants world. They have independent prothallus and sporophytic stages in their life-cycles. Prothallus has significant difference with its sporophyte in morphological structure, and it is crucial to complete the life-cycle of a pteridophyte. This book summarized a study on a collection of 454 species of pteridophyte from tropical and subtropical areas of China, South-east Asia, Australia and Malaysia, and included more than 2000 photographs showing morphological features of the sporophytes, mature prothallus and part of young sporophytes and brief interpretations there of. It could provide information for researchers and production technical personnels in the fields of botany, biology of reproduction *etc.*; meanwhile it could also be used as a reference for college teachers and students in related subjects.

## **深圳蕨类植物活体保存中心项目顾问委员会**

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## **出版资助**

深圳市城市管理局

深圳市亚热带植物多样性重点实验室

深圳市城市管理科学研究所

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Su-Hua Wu, Liang-Sheng Xie

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Shenzhen Urban Management Bureau

Shenzhen Key Laboratory of Southern Subtropical Plant Diversity

Scientific Institute of Shenzhen Urban Management





蕨类植物是植物界中一个独特的类群，其生活史有明显的世代交替现象，具可独立生活的原叶体世代和孢子体世代。原叶体的正常生长和发育是完成蕨类植物生活史的关键。这种微小的、具腹背分化的绿色片状物与孢子体在形态结构上有明显差异。原叶体的形态特征有助于阐明蕨类植物之间亲缘关系，但由于原叶体在野外观察困难，所以反映蕨类植物完整生活史的彩色照片不多，资料相对缺乏。

仙湖植物园自建园始一直致力于蕨类植物引种驯化的工作。在深圳市科技创新委员会以及深圳市城市管理局城管科研基金资助下，先后开展了“深圳蕨类植物资源调查与利用”和“蕨类植物规模繁殖技术研究及其在园林景观上的应用”等研究，收集了不同地域的蕨类植物达700余种，并在园区的荫生植物区、孢子植物区进行了种植和展示。本书第一作者从事蕨类植物研究20余年，于2008年底受聘于仙湖植物园，从事蕨类植物引种驯化特别是繁殖等方面的工作，积累了大量的孢子体、成熟原叶体和部分幼孢子体的照片，后经过选择和整理，编撰成此书。读者可通过这些资料，理解蕨类植物的多样性，厘清蕨类植物之间的亲缘关系；同时该书对植物学、繁殖生物学等科研领域以及观赏、药用、食用蕨类植物的生产繁殖工作提供参考。

该书收集的蕨类植物主要来自我国西南、华南和台湾地区，此外还有部分种类来自越南、老挝、澳大利亚和马来西亚。全书按《中国植物志》（英文版）第2-3卷的系统排列（Christenhusz, 2011, 略有改动），种类则按拉丁字母顺序排列，包含37科137属454种，以2000余幅彩色图片展示了蕨类植物孢子体和原叶体世代的形态特征，并附有中英文对照索引。文字部分包括中文名，学名，孢子材料来源，培养条件，图片简要信息，及在相关植物志和参考文献中的卷册和页码，以便读者查阅。

本书解读：孢子保存期——指孢子叶片剪下装入纸袋（常温保存）到孢子播种的天数；孢子萌发时间——指孢子播种后到在体视镜下观察到孢子壁开裂处长出1~2个绿色细胞的天数；不同种类的培养是在不同的时间、地点



(昆明、深圳)，通过荫棚或培养室进行培养的。受当地自然气候的影响，荫棚内培养的种类原叶体形成幼孢子体的周期会延长。在培养中保持空气湿度90%~95%时，影响原叶体长宽比和周期率的直接因素是温度和光照强度，大多数蕨类最适培养温度是 $25 \pm 1^\circ\text{C}$ ，温度过高或过低均制约原叶体的正常发育，在最适的温度下光照强度是原叶体发育的关键因素。因此同一种蕨类植物在不同的生境条件下生长，其原叶体的发育周期、长宽比、甚至形体都会有差异。培养的方法和条件：①使用经高温消毒的培养土（腐殖质土：原生土=2:1）为培养基质，在土壤上喷洒浓度为100~200ug/g的植物激素 $\text{GA}_3$ 有利于促进孢子萌发。②将蕨类孢子均匀地撒播在培养基质的表面，保持湿度95%~100%。③遮荫棚内的温度为自然环境温度，遮荫网的密度为90%，光照强度800~1600 lx。④培养室使用日光灯培养架，光照时间12小时/天，光照强度1000~1500 lx，温度为10~28℃。

本书的编写是在仙湖植物园前主任李勇博士的组织下开展的，得到了历任园主任的鼓励，并得到了蕨类植物活体保存中心项目（FLSF-2009-003）的支持。在历年的孢子采集、繁殖实验过程中，得到了昆明市金殿植物园、中国科学院昆明植物研究所的支持和协助；著名蕨类植物学家、云南大学朱维明教授在部分种类鉴定方面给予了帮助；中国科学院昆明植物研究所武素功研究员、向建英博士提供了越南、老挝考察项目（U. S. National Geographic Society, grant number: 6300-98 and 7312-03）采集的孢子材料；仙湖植物园的同事陈珍传、郎校安、张力、刘红梅、董慧等提供了许多野外采集的孢子材料和孢子体图片。作者对上述的帮助深表谢意。

遗憾的是本书未能展示蕨类植物的孢子形态和原叶体生殖结构信息，书中难免有错误和不足，敬请读者批评和指正。

著者

2013年8月28日



Pteridophytes are unique in plants world. They have two distinct and alternating generations in their life-cycles, i.e. the prothallus and the sporophyte generations. A new plant of pteridophyte can only arise from a prothallus, therefore, growth and development of prothallus is an important step in the life-cycle. With an upper and lower surface differentiation, this tiny green plate has significant differences with sporophyte in the morphological structure, and this morphological feature is helpful to clarify the relationship between different species of pteridophytes. However, as the prothallus is quite difficult to be observed in the field, the colored photographs which can reflect the whole life-cycle of pteridophyte is relative insufficient.

Since its establishment, Fairylake Botanical Garden has been committed to the introduction and domestication of pteridophyte. With the fund support from Shenzhen Science and Technology Innovation Committee and scientific research fund of Shenzhen Urban Management Bureau, Fairylake Botanical Garden successively has conducted researches on “*the survey and utilization of fern resource in Shenzhen*” and “*the study on scale propagation technique of fern and its application in landscape design*” etc.. Through those project, collection had increased in size with more than 700 species of pteridophyte from different regions. At the same time, the collection had been used in enriching the display in the shady plants area and spore plants area of Fairylake Botanical Garden. The first author of this book has been engaged in the study of pteridophytes for more than 20 years, and came to Fairylake Botanical Garden in 2008 to join in the research team on introduction and domestication of pteridophytes. After years of work, she has accumulated many photographs about fern sporophytes, mature prothallus and part of young sporophytes. Based on these photographs and through selection and reorganization, this book is compiled. We hope that



readers will get a better understanding about the diversity of pteridophytes as well as their relationship after referring to this book. At the same time, this book would also provide reference to the research fields such as botany and biology of reproduction, as well as the reproduction of ornamental, medicinal and edible pteridophytes.

Pteridophytes within this book are mainly from Southwest China, South China and Taiwan China, in addition, part of them are from Vietnam, Laos, Australia and Malaysia, including 37 families, 137 genera and 454 species. Families and genera are arranged in the system of *Flora of China Vol. 2-3* (Christenhusz's, 2011, with a little modification). In order to show the morphological features of sporophyte and prothallus generation of each pteridophytes, this book use more than 2000 colored photographs. The text part consists of Chinese name, scientific name, the spore source, culture condition and brief interpretation about photographs. Volume and page number of relevant flora and references are also attached for readers to access.

Interpretation of this book: spores storage time refers to the days from the spore pinna or blade being placed into paper bag (room temperature preservation) to sowing. Germinating time refers to the days that it takes for the spore wall to crack and one or two green cell to emerge under the observation of stereoscope. It should be also noted that these spores are cultivated in different time and location (Kunming and Shenzhen) and cultured under sun shelter or in culturing room, respectively. Influenced by the local climate, the period that prothalli cultivated under sun shelter forms young sporophyte will be extended. When the surrounding air humidity keeps from 90% to 95% during the cultivation, the direct factors which influence the prothallus' length-width ratio and growth time are temperature and light intensity. Suitable temperature

to cultivate most species is  $25\pm 1^{\circ}\text{C}$ . If the temperature is kept overly high or low, then the natural growth of prothallus will be also restricted. Under the suitable temperature, light intensity is the most crucial factor for the growth of prothallus. Therefore, if a species of pteridophyte grows in different habitat conditions, its prothallus' growth period, length-width ratio, even shape will have differences. Cultivation methodology and conditions: ①Cultivation soil (humus soil: yellow soil=2:1) which going through high temperature sterilization is chosen for the culture medium. Spraying of plant hormone  $\text{GA}_3$  (100–200 $\mu\text{g/g}$ ) on surface of culture medium is helpful to promote the germinating of spores; ②spores are sown evenly on the culture medium and the humidity is kept between 95% to 100%; ③the temperature under sun shelter is natural environment temperature, density of shade-net is 90%, light intensity is 800–1600 lx. ④The culture shelf with fluorescent lamp is used in culturing room, lighting time is 12 hours per day, light intensity is 1000–1500 lx, the temperature range in culturing room is 10–28 $^{\circ}\text{C}$ .

The compiling of this book was under the organization of Dr. Yong Li, the former director of Fairylake Botanical Garden. This work was also encouraged by present and former directors of Fairylake Botanical Garden and supported by the program (FLSF-2009-003) of ferns conservation center. Spores collection and reproduction experiment work was supported and assisted by Kunming Jindian Botanical Garden and Kunming Institute of Botany, Chinese Academic of Sciences. The famous pteridologists from Yunnan University, Professor Wei-Ming Chu, kindly helped with species identification. Mr. Su-Gong Wu and Dr. Jian-Ying Xiang from Kunming Institute of Botany, Chinese Academic of Sciences, shared spores collected in the Vietnam and Laos programmes (U. S. National Geographic Society, grant number: 6300–98 and



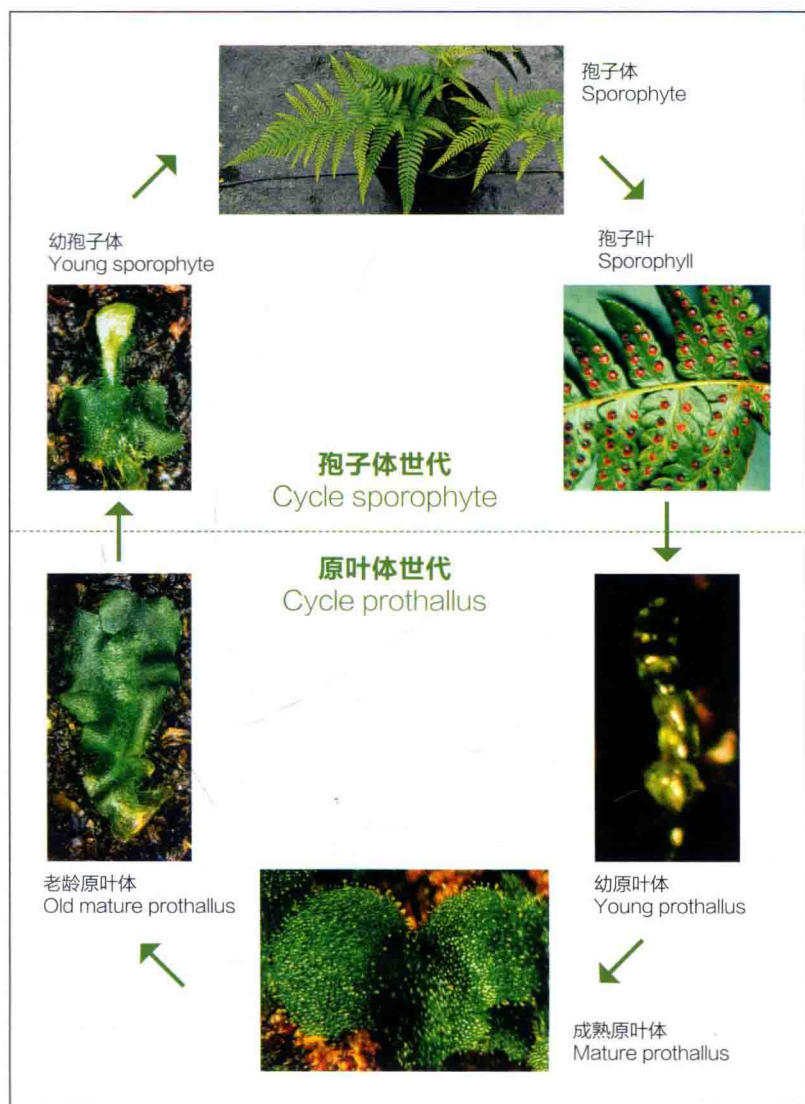
7312-03). Colleagues of Fairylake Botanical Garden Mr. Zhen-Chuan Chen, Mr. Xiao-An Lang, Dr. Li Zhang, Dr. Hong-Mei Liu, and Dr. Hui Dong offered various spores collected from the field and they also offered many photographs of sporophyte. Hereby, we would like to express our most sincere gratitude to them.

However, it is regret that this book doesn't show the morphological features of spores and reproductive structure of prothalli. Mistakes and deficiencies are inevitable in this book thus any correction from readers will be appreciated.

The authors  
28 August 2013

图解 Illustration



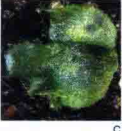
蕨类植物的生活世代 Life Cycle of Pteridophyte







## 如何使用本书 Instructions of the Book

	属 Genus	科 Family
中文名 Chinese name	碗蕨属 <i>Dennstaedtia</i>	碗蕨科 <i>Dennstaedtiaceae</i>
本物种的参考文献	尾羽蕨	
孢子来源	《Ferns of Malaysia in Colour》245页, 1988年。	
培养条件	孢子来源 阿根廷科尔多巴, 张寿洲 120009。	
图片说明	培养条件 孢子保存10天; 培养基: 6天萌发, 温度 16–28°C, 平均23.4°C。	
学名 Scientific name	图片 A (张寿洲): 孢子体; B: 原叶体 2 mm × 3 mm / 2个月; C: 原叶体 5 mm × 6 mm个月; D: 幼孢子体 4 mm × 10 mm / 5.5个月。	
References	<i>Pteridium caudatum</i> (L.) Maxon Ferns of Malaysia in Colour 245. 1988.	
Spore source	Spore source Cordoba in Argentina. Shou-Zhou Zhang. 120009.	
Culture condition	Culture condition Spores storage times: 10d; Germinating time: 6d; Temperature range 16–28°C (Average 23.4°C); In the lab.	
Photo-interpretation	Photos A (Shou-Zhou Zhang): Sporophyte; B. Prothallus 2 mm × 3 mm in 2 months; C. Prothallus 5 mm × 6 mm in 5.5 months. D. Young sporophyte 4 mm × 10 mm in 5.5 months.	
图片 Photo	 A	 B  C  D

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图片摄影者  
(没有标注摄影者的, 均为本书第一作者摄影)

Photographer  
(If there is no indication, it is from Yu Jiao)



## 石松科 Lycopodiaceae

石杉属 *Huperzia* Bernh.

蛇足石杉 *Huperzia serrata* (Thunb.) Trev. ....1

石松属 *Lycopodium* L.

垂穗石松 *Lycopodium cernuum* L. ....2

## 水韭科 Isoetaceae

水韭属 *Isoetes* L.

云贵水韭 *Isoetes yunguiensis* Q. F. Wang & W. C. Taylor .....3

## 卷柏科 Selaginellaceae

卷柏属 *Selaginella* P. Beauv.

宛州卷柏 *Selaginella involvens* (Sw.) Spring .....4

毛枝卷柏 *Selaginella trichoclada* Alston .....5

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披散木贼 *Equisetum diffusum* D. Don .....6

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绒毛阴地蕨 *Botrychium lanuginosum* Wall. ex Hook. & Grev. ....7

瓶儿小草属 *Ophioglossum* L.

瓶儿小草 *Ophioglossum vulgatum* L. ....8

## 松叶蕨科 Psilotaceae

松叶蕨属 *Psilotum* Sw.

松叶蕨 *Psilotum nudum* (L.) P. Beauv. ....9

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## 马通蕨科 *Matoniaceae*

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