CForBio “中国森林生物多样性监测网络”丛书 马克平 主编

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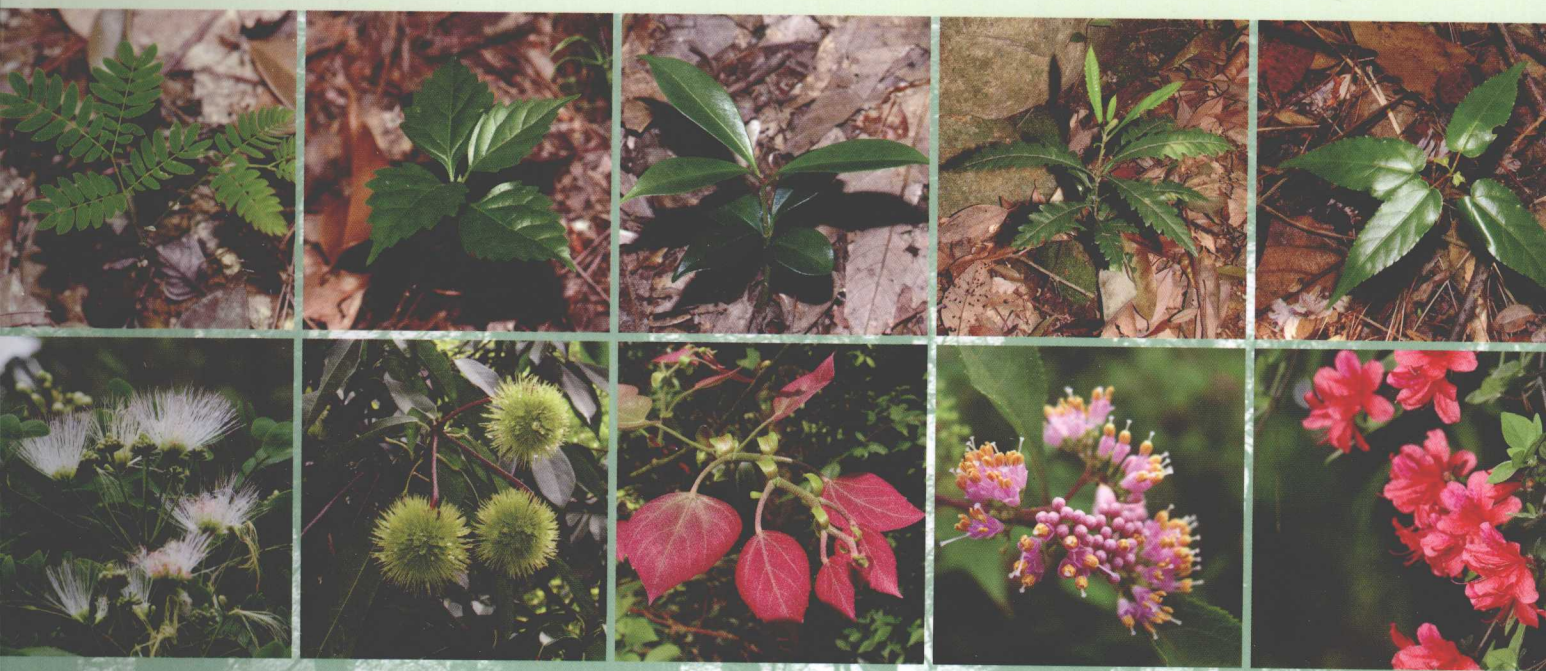
——树种及其分布格局

Gutianshan Forest Dynamic Plot
Tree Species and Their Distribution Patterns

陈 彬 米湘成 方 腾 陈 磊 任海保 马克平 著



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内容简介

本书介绍了浙江省古田山亚热带常绿阔叶林常见木本植物159种，每个树种除了文字描述外，还配有三张精美的照片，展示植物的小枝、花序、果实和幼苗等，方便识别。同时，附有每种植物在24hm^{2}长期定位研究样地内的种群分布图以及种群的个体数量和径级结构。对于该样地的地形、土壤、植被等皆有介绍。本书以资料翔实、图片精美为特色，是亚热带常绿阔叶林研究不可多得的参考书，也可以作为植物爱好者了解亚热带森林、认识森林植物的野外指导手册。

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序 言1

在过去的几十年时间里，中国科学院和林业、农业等相关部门陆续建立了数百个生态系统定位研究站。其中，中国科学院组建的中国生态系统研究网络(CERN)拥有分布于全国包括农田、森林、草地、湿地、荒漠等生态系统类型的36个生态站。国家林业局建立的中国森林生态系统研究网络(CFERN)由29个生态站组成，基本覆盖了我国典型的地带性森林生态系统类型和最主要的次生林、人工林类型。

随着研究的发展，特别是近年来人们对生物多样性和全球变化研究的关注，国际上正在推动生态系统综合研究网络平台的建立。在全球水平上，全球生物多样性综合观测网络（GEO-BON）是一个有代表性的研究网络。它试图把全球与生态系统和生物多样性长期定位研究相关的网络整合起来，通过综合研究，探讨生态系统与生物多样性维持与变化机制以及系统之间的相互作用机理，为生态系统可持续管理与生物多样性的保护提供科学依据和管理模式。

近年来，中国科学院生物多样性委员会组织建立了中国森林生物多样性监测网络（Chinese Forest Biodiversity Monitoring Network，以下简称 CForBio）。中国是生物多样性特别丰富的少数国家之一，也是唯一一个具有从北部寒温带到南部热带完整气候带谱的国家。CForBio对于揭示中国森林生物多样性形成和维持机制，以及森林生物多样性对全球变化的响应，科学利用和有效保护中国森林生物多样性资源具有重要意义。目前，CForBio已建成4个大于20hm^{2}的监测样地，分别是长白山阔叶红松林（25 hm^2）、古田山亚热带常绿阔叶林（24 hm^2）、鼎湖山南亚热带常绿阔叶林（20 hm^2）和西双版纳热带雨林（20 hm^2）。广西弄岗、浙江天童、河南伏牛山和北京东灵山的大型监测样地正在建设中。此外，还有若干5 hm^{2}的样地，如吉林长白山白桦林、北京东灵山辽东栎林、浙江百山祖常绿阔叶林和四川都江堰常绿落叶阔叶混交林样地。CForBio是继美国史密森研究院热带研究所建立的热带森林生物多样性监测网络（CTFS）之后又一大型区域生物多样性监测网络。由于CForBio横跨多个纬度梯度，对揭示生物多样性科学的基本规律有特殊意义，在国际生物多样性监测网络中具有重要地位。

目前，CForBio已经有很好的研究进展，各样地研究成果陆续在国际著名生态学刊物如*Ecology, Journal of Ecology, Oikos*等上发表，受到国内外同行的高度评价。但这些文章都是关于某一具体问题的研究总结，还无法让国内外同行全面了解CForBio各个样地整体情况。因此，出版这套以中英文形式介绍各大样地基本情况的“中国森林生物多样性监测网络”丛书是非常必要的。感谢马克平研究员组织相关专家编写这套丛书。我相信该丛书不仅是国内外同行深入了解CForBio各样地的参考书，同时也将为我国森林生物多样性监测和森林生态系统联网研究奠定重要的基础。

Foreword 1

In the past few decades, hundreds of Ecosystem Research Stations have been set up by the Chinese Academy of Sciences, State Forestry Administration, Ministry of Agriculture and other relative departments. Among them, 36 ecological research stations were established by Chinese Ecosystem Research Network (CERN), supported by the Chinese Academy of Sciences. The 36 research stations are scattered over the country representing diverse ecosystems, including farmland, forest, grassland, wetland, desert and others. Moreover, the Chinese National Ecological Research Network (CFERN), supported by the State Forestry Administration, consists of 29 research stations, covering typical zonal forest ecosystems and main secondary forests and plantations in China.

With the development of research, especially the growing concern over researches on biodiversity and global change in recent years, the establishment of ecosystem research network have been promoted under international supports. So the Group on Earth Observations Biodiversity Observation Network (GEO-BON) is representative across the world, and it attempts to integrate worldwide networks relating to long-term research on ecosystem and biodiversity. Based on the comprehensive studies, the maintenance and change mechanism of ecosystem and biodiversity and their interactions have been explored, which provide scientific basis and management mode for sustainable development of ecosystem and protection of biodiversity.

In recent years, Chinese Forest Biodiversity Monitoring Network (CForBio) has been built by Biodiversity Committee of the Chinese Academy of Sciences. China is one of the few top "mega-biodiversity countries" in the world, and it is also the only country with full climatic zone spectrum, ranging from northern cool temperate zone to southern tropical zone. Besides, CForBio is of great significance to reveal the formation and maintenance mechanism of forest biodiversity in China and their response to climate change

Four permanent plots with area larger than 20-ha have been built at present. They are 25-ha temperate broad-leaved Korean pine mixed forest plot in Changbaishan, 24-ha subtropical evergreen broad-leaved forest plot in Gutianshan, 20-ha lower subtropical evergreen broad-leaved forest plot in Dinghushan and 20-ha tropical rain forest plot in Xishuangbanna. Moreover, other four large-scale permanent forest plots are being built: Longgang in Guangxi, Tiantongshan in Zhejiang, Funiushan in Henan and Donglingshan in Beijing. Besides, a number of 5-ha plots have also been built, including birch forest plot in Changbaishan, Jiling province, oak forest plot in Donglinshan, Beijing, evergreen broad-leaved forest plot in Baishanzu, Zhejiang province and evergreen and deciduous broad-leaved mixed forest plot in Dujiangyan, Sichuan province. Now, CForBio is another regional biodiversity monitoring network after the Center for Tropical Forest Science (CTFS). As being across several latitudinal gradients, CForBio is not only important to examining the fundamental mechanism of biodiversity maintenance, but also plays an important role in Global Biodiversity Monitoring Network.

Encouraging progress has been made in this area since the network built, for lots of research findings have been published in the international peer reviewed ecological journals, such as *Ecology, Journal of Ecology* and *Oikos,* etc., which brought about positive response from colleagues in the field of plant ecology. However, the published papers mostly focus on research of specific problems; scientists and public still can't understand the whole situation of each plot in details. So it is really necessary to publish this series, which introduce basic information of permanent forest plots in both Chinese and English. I am grateful to Professor Keping Ma for organizing related specialists to prepare the series. And I believe that this series would be a valuable reference book for scientists and public to further understand CForBio, and it will also lay a foundation for the forest biodiversity monitoring and forest ecosystem research in China.

Honglie Sun
The former Vice-President for the Chinese Academy of Sciences

序　言2

森林在维持世界气候与水文循环中起着根本性的作用。森林是极为丰富多样的动物、植物与微生物的家园，而人类正是依靠这些生物获取各种产品，包括食品与药物。尽管对人类福祉如此重要，森林仍然遭受着来自土地利用与全球气候环境变化的巨大威胁。在这种不断变化的情况下，为了更好地管理全球剩余的森林，迫切需要树种在生长、死亡与更新方面的详细信息。

中国森林生物多样性监测网络（CForBio）正在中国沿着纬度与环境梯度建立大尺度森林监测样地。通过这个重要的全国行动倡议与来自中国科学院及若干其他单位的研究者的努力，CForBio开始搜集关于中国森林的结构与动态的关键信息。现在CForBio与史密森研究院及哈佛大学阿诺德树木园的热带森林监测网络（CTFS）形成了合作伙伴。CTFS是个在21个热带或温带国家拥有长期大尺度森林动态研究样地的全球性网络。CForBio与CTFS合作的目标是通过合作研究，了解森林是如何运作的，它们是如何随着时间而改变的，以及如何重建或者恢复，以确保森林提供的环境服务能可持续或者增长。森林及其提供的服务的长期可持续性有赖于我们预测森林对全球变化，包括气候与土地利用变化的响应的能力，以及我们去理解与创建适当的森林服务市场的能力。通过拥有34个森林大样地的全球网络及大量项目的训练与能力建设，CForBio与CTFS的伙伴关系是发展这些预测工具的重要基础。这种伙伴关系也将促进为全球各地的当地社区、林业管理者与政策制定者在森林的保育与管理方面发展应用性的林业项目建议，发展与示范利用乡土物种进行森林重建的方法，以及从经济学角度评估森林在减缓气候变化、生物多样性保护和流域保护上的价值的方法。

我祝贺作者们创作了这部关于样地植物的优秀丛书。本丛书为将来的森林监测提供了基准信息，是涉及森林恢复、碳存储、动植物关系、遗传多样性、气候变化、局地与区域保育等研究内容的研究者、学生与森林管理者们有价值的参考资料。

S. J. 戴维斯
主任
史密森热带研究所&哈佛大学阿诺德树
木园热带森林科学研究中心

Foreword 2

Forests play an essential role in regulating of world's climatic and hydrological cycles. They are home to a vast array of animal, plant and microorganism species on which humans depend for many products, including food and medicines. Despite the importance of forests to human welfare they are under enormous threat from changes in land-use and global climatic conditions. In order to better manage the world's remaining forests under these changing conditions detailed information on the dynamics of growth, mortality and recruitment of tree species is urgently needed.

The Chinese Forest Biodiversity Monitoring Network (CForBio) that aims to establish large-scale forest monitoring plots across latitudinal and environmental gradients in China. Through this important national initiative, researchers from the Chinese Academy of Sciences and several other research institutions in China, CForBio has begun to gather key information on the structure and dynamics of China's forests. The CForBio initiative is now partnering with the Center for Tropical Forest Science (CTFS) of the Smithsonian Research Institute and the Arnold Arboretum of Harvard University. CTFS is a global program of long-term large-scale forest dynamics plots in 21 tropical and temperate countries. The goal of the partnership between CForBio and CTFS is to work together to understand how forests work, how they are changing over time, and how they can be re-created or restored to ensure that the environmental services provided by forests are sustained or increased. The long-term sustainability of forests and the services they provide depend on our ability to predict forest responses to global changes, including changes in climate and land-use, and our ability to understand and create appropriate markets for forest services. The CForBio-CTFS partnership is ideally poised to develop these predictive tools through a global network of 34 large forest plots and an extensive program of training and capacity building. The partnership will also lead to the development of applied forestry programs that advise local communities, forest managers and policy makers around the world on conservation and management of forests, to develop and demonstrate methods of native species reforestation, and to economically value the roles that forests play in climate mitigation, biodiversity conservation, and watershed protection.

I congratulate the authors on the production of this excellent new series of stand books. In addition to providing a baseline for future forest monitoring, these books provide a valuable resource for researchers, students, and forest managers dealing with issues of forest restoration, carbon storage, plant-animal interactions, genetic diversity, climate change, and local and regional conservation issues.

Director
Center for Tropical Forest Science
The Smithsonian Tropical Research Institute &
The Arnold Arboretum of Harvard University

前　言

我国的常绿阔叶林在世界范围内分布面积最广，发育最为典型，为同类植被中罕见的类型，其中亚热带是常绿阔叶林的典型分布区，其分布范围约位于北纬24°～32°，东经99°～123°之间，是我国重要植被类型之一。

我国的研究工作者在亚热带常绿阔叶林区逐步建立了各具区域特色的常绿阔叶林研究基地，对常绿阔叶林的物种组成和空间分布结构有一定的研究积累。但这些研究的样地面积小、监测时间短，难于涵盖众多稀有物种，较难反映群落内不同尺度上的生物多样性格局和过程，不足以认识群落水平上生物多样性维持机制，因此有必要在亚热带典型常绿阔叶林地带建立大面积长期监测样地，监测常绿阔叶林从种子雨散布、幼苗更新和成株的变化动态过程，以及动物和微生物类群的变化及其功能，探索常绿阔叶林的生物多样性形成和维持机制。

浙江省古田山国家级自然保护区具有亚热带常绿阔叶林丰富的种类和独特的类群，目前还保存着很好的低海拔天然植被，这在中亚热带东部地区十分少见，而且古田山自然保护区也是国际生物多样性保护的热点地区，在该自然保护区选择典型的地带性植被甜槠-木荷林作为长期监测样地，监测和研究常绿阔叶林的生物多样性形成和维持机制，具有典型性和代表性。基于上述原因，生物多样性委员会组织中国科学院植物研究所、浙江大学、古田山国家级自然保护区管理局等单位，采用CTFS（Centre for Tropical Forest Science）样地建设标准，于2004～2005年建成了24hm^{2}的永久监测样地，以期对古田山常绿阔叶林生物多样性进行长期监测与研究。我国是世界上唯一跨越多个气候带的国家，古田山样地和长白山样地、鼎湖山样地、西双版纳样地等分别代表不同气候带的地带性植被，同时成为中国森林生物多样性长期监测网络的核心组成部分。

本书详尽地描述了古田山24 hm^{2}样地常绿阔叶林群落的物种特性、分布格局和径级结构，而精美的样地植物照片让读者对本书的内容有更感性的认知。同时本书也是古田山样地建设启动以来5年左右工作积累的展现，为未来样地的深入研究提供了必备的基础生态信息，也期待吸引更多的年轻学子加入森林生态学的探索行列。

在地形复杂的古田山建设大型的长期监测样地，是一个前所未有的挑战。在样地建设的过程中得到了方方面面的大力帮助。借此机会，诚挚地感谢下列单位和同事对样地建设所作出的贡献：

(1) 提供科学及技术支持的加拿大阿尔伯塔大学何芳良教授、东海大学孙义方教授、温州大学丁炳扬教授、浙江大学于明坚副教授和丁平教授、浙江师范大学陈建华副教授、哈佛大学Stuart Davies 博士；

(2) 提供工作和生活便利的古田山国家级自然保护区管理局胡青延局长、钱海源副局长、郑球星副局长、吕一锋副局长、余建平主任、郑东红主任、方藤工程师、陈声文工程师、尤登法、詹翠玉、程凌宏、吴应红和开化县苏庄镇姜瑞根；

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(4) 参加样地建设的中国科学院植物研究所米湘成、任海保、宫贵权、黄继红、张俪文，浙江大学于明坚、赵谷风、沈国春、慎佳泓、张洋、张磊、黄军、余佳、王琰琰、苏莹雪、胡轭，浙江师范大学陈建华、黄敏、陈庆杰、夏振国、丁高兴、黄秋生、李立、李侠、宋瑞生、杨武、蒋华伟，中国计量学院唐乔、李力霖，温州师范学院丁炳扬、姜雪华，开化县苏庄镇赖祯熙、姜智勇。

时间仓促，水平所限，错误疏漏在所难免，敬请各位读者不吝赐教。

Preface

China is the central area of evergreen broad-leaved forest in the world, and evergreen broad-leaved forest in China is characterized by its typical development and vast distributional area in southwestern and southeastern part of China. As one of important vegetation types in China, evergreen broad-leaved forest is mainly distributed in subtropical zone ranging from 24° -32° N to 99° -123° E.

Based on observational stations in different parts of evergreen broadleaved forests, Chinese ecologists have studied evergreen broadleaved forests for decades and had many publications in species composition, spatial distribution and so on. However, these studies were usually biased to short period observations on small plots (smaller than 1 ha) which are unable to includes the large number of rare species in this region. Therefore, the studies can hardly reflect patterns and processes of evergreen broadleaved forests across scales, and are not sufficient to shed light on mechanisms of biodiversity maintenance at community level. In order to explore mechanisms of biodiversity origin and maintenance, it is imperative to establish long-term large scale forest dynamic plot and to monitor the dynamic processes from seed dispersal and seedling recruitment to adult, and interactions among forests, animals and microbes.

As an international biodiversity hot spot, Gutianshan National Nature Reserve processes well-protected old-growth evergreen broadleaved forests at low altitude, which can hardly be found in eastern area of subtropical zone. These forests are rich in representative species and community types of evergreen broadleaved forests. It is typical and representative to study mechanisms of biodiversity origin and maintenance based on forest dynamic plot (FDP) in Castanopsis eyrei-Schima superba forest of the Reserve. By these lines of considerations, Biodiversity Committee of Chinese Academy of Sciences organized Institute of Botany, Zhejiang University and Administrative Bureau of Gutianshan Nature Reserve to establish Gutianshan 24 ha FDP following the standard census protocol of CTFS (Center for Tropical Forest Science). China is unique country across multiple climate zones in the world, and Gutianshan 24-ha FDP will be core component together with Changbaishan 25-ha FDP, Dinghushan 20-ha FDP and Xishuangbanna 20-ha FDP representing zonal vegetations across climate zones and constituting the Chinese Forest Biodiversity Monitoring Networks (CForBio).

We have attempted to describe the species characteristics, distribution pattern and DBH size classes found in Gutianshan FDP in this book. This book contains a large number of beautiful photos of seedlings, flowers, fruits and seeds and adult trees accumulated in the five-year studies during and after the plot establishment. This book provides baseline eco-information for future studies, and attempt to attract more youths to join the exploration of forest ecology.

It is an unprecedented challenge to establish large scale forest dynamic plot in terrain-rugged Gutianshan National Nature Reserve. Were it not for their joint contributions and persistence, Gutianshan FDP could not have been established. Hence, the authors greatly acknowledge the following people and institutions for their admirable contributions to the establishment of Gutianshan FDP:

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Ma Keping

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1. 古田山自然保护区

1.1 地理位置和自然环境

古田山国家级自然保护区（29°10′19.4″～29°17′41.4″N，118°03′49.7″～118°11′12.2″E），位于浙江省开化县西部的苏庄镇境内，总面积8107hm^2，地处亚热带季风气候区，同时由于山势高峻，山体东北-西南走向，使湿润的夏季风能长驱直入，带来丰沛的降水，而干燥寒冷的冬季风则被山体阻挡，从而形成冬暖夏凉、温暖湿润、雨量充沛的气候特点。年平均温度15.3℃，年平均降水1963.7mm，每年的3～6月为第一雨季，7～8月为伏旱季，8月底至9月受台风影响形成第二雨季，10～12月为干期。

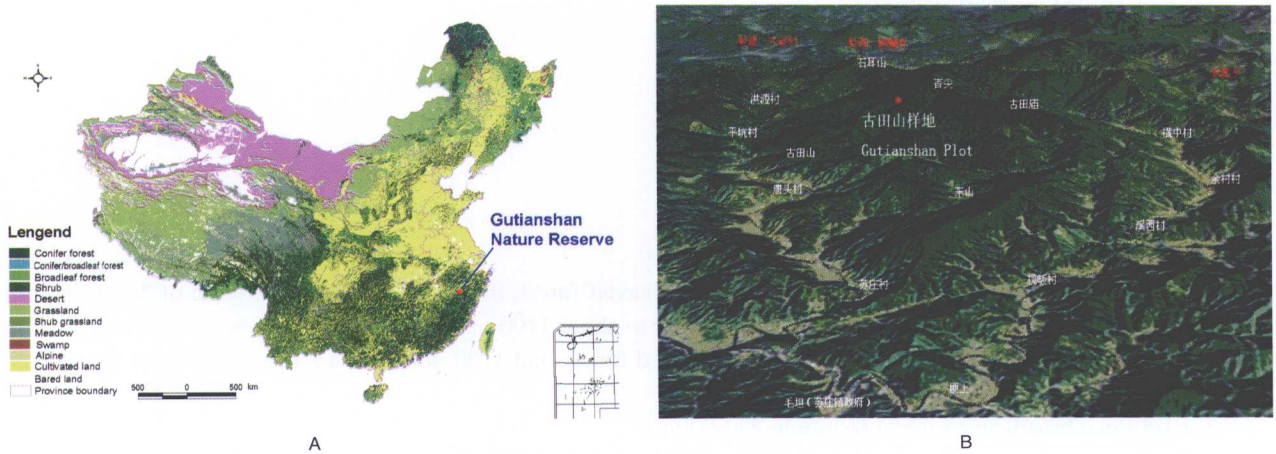
古田山土壤基本上是由母岩风化形成，主要有红壤、黄红壤、红黄壤和沼泽土4大类，其中红壤、黄红壤、红黄壤占全区总面积80%以上，分别分布于海拔500～700m，700～1000m和1000m以上。土壤土表残落物层较薄，C/N比不高，绝大多数土壤呈酸性反应。

Introduction to Gutianshan 24-ha Forest Dynamic Plot

1. Introduction to Gutianshan Nature Reserve

1.1 Location and description of Gutianshan Nature Reserve

Gutianshan National Nature Reserve (29°10′19.4″~29°17′41.4″N, 118°03′49.7″~118°11′12.2″E), approximately 8,107 hectares, is located in Kaihua County, Zhejiang Province in east China. The local climatic characteristic is formed by interaction of subtropical monsoon climate and the land form, mainly the high and steep mountains. In summer, warm and mild wind from northeast brings rich precipitation; whereas in winter, cold and dry wind is blocked out and has limited influence on local climate. Annual mean temperature in the region is 15.3



A B

古田山自然保护区的位置及24hm^{2}样地在古田山保护区中的位置

A. 古田山自然保护区的位置； B. 24hm^{2}样地在古田山保护区中的位置

Map of China showing the location of the 24-ha Gutianshan permanent plot, eastern China.

A. The location of Gutianshan Nature Reserve in China; B. The location of 24 ha forest plot in Gutianshan Nature Reserve.

centidegree, annual mean precipitation, calculated from data of years from 1958 to 1986, is 1963.7mm, majority of which occurs between March and September.

Weathering and denudation of the mother rock ultimately formed 4 central types of soil in Gutianshan: red soil, yellow soil, red-yellow soil and yellow-red soil, the former three account for more than 80% of the total area, and are mainly distributed in 500~700m, 700~1000m, above 1000m a.s.l., respectively. The litter cover is generally thin, the carbon-nitrogen ratio is usually narrow, and the vast majority of soil shows acid reaction.

1.2 主要植被类型

常绿阔叶林是古田山分布面积最广的植被类型，主要分布于海拔350～800m的山坡和山麓；在海拔720m（山脊）和800m（山谷）至海拔1100m左右，大片分布着黄山松针阔叶混交林，海拔1100m以上至山顶为黄山松林。主要类型包括：

I. 常绿阔叶林（海拔400～900m）

（1）甜槠林（主要类型）：a. 甜槠－青冈林；b. 甜槠－石栎林；c. 甜槠－木荷林；

（2）栲树林；

（3）野含笑－钩栗林；

（4）青冈林；

（5）虎皮楠－甜槠林；

（6）乌冈栎－青冈林。

II. 常绿落叶阔叶混交林

（1）山地常绿落叶阔叶混交林：短柄枹－细叶青冈林；

（2）沟谷常绿落叶阔叶混交林：a. 南酸枣－紫楠林；b. 红毒茴－紫茎林。

III. 暖性针阔叶混交林

（1）马尾松－木荷－甜槠林；

（2）马尾松－青冈林。

IV. 温性针阔叶混交林

（1）黄山松－木荷林；

（2）黄山松－细叶青冈林。

V. 暖性针叶林

马尾松林。

VI. 温性针叶林

黄山松林。

1.2 Main Vegetation Types

Most of the region is covered by ever-green broadleaved forest, mostly distributed at altitude of 350 to 800 m on hillside and foothill. Vegetation on the ridge from 720 to about 1100 m and in the valley between 800 and 1100 m is mainly the deciduous broadleaved and coniferous mixed forest, and 1100 m above is *Pinus taiwanensis* forest. The following are main vegetation types:

I. Evergreen broadleaved forest (Altitude 400-900m)

(1) *Castanopsis eyrei* Forest (Main type): a. *Castanopsis eyrei-Cyclobalanopsis glauca* forest; b. *Castanopsis eyrei-Lithocarpus glaber* forest; c. *Castanopsis eyrei-Schima superba* forest;

(2) *Castanopsis fargesii* Forest;

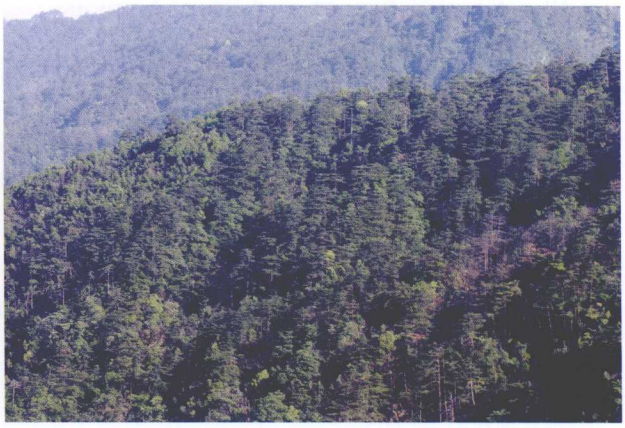
(3) *Manglietia skinnneriana-Castanopsis tibetan* forest;

(4) *Cyclobalanopsis glauca* forest;

A

B

C



D

古田山自然保护区不同的森林类型

Different types of forests in Gutianshan Nature Reserve

A. 常绿阔叶林 Evergreen broadleaved forest; B.常绿落叶阔叶混交林 Evergreen and deciduous broadleaved mixed forest; C. 针阔混交林 Coniferous and broadleaved mixed forest; D.针叶林 Coniferous forest

(5) *Daphniphyllum oldhami-Castanopsis eyrei* forest;

(6) *Quercus phillyraeoides-Cyclobalanopsis glauca* forest.

II. Evergreen broadleaved and deciduous broadleaved mixed forest

(1). Mountain evergreen broadleaved and deciduous broadleaved mixed forest;

Quercus serrata-Cyclobalanopsis gracilis forest:

(2). Ravine evergreen broadleaved and deciduous boradleaved mixed forest: a. *Choerospondias axillaris-Phoebe sheareri* forest; b. *Illicium lanceolatum- Stewartia sinensis* forest.

III. Warm temperate deciduous broadleaved and coniferous mixed forest

(1) *Pinus massoniana-Schima superba-Castanopsis eyrei* forest;

(2) *Pinus massoniana-Cyclobalanopsis glauca* forest.

IV. Temperate deciduous broadleaved and coniferous mixed forest

(1) *Pinus taiwanensis-Schima superba* forest;

(2) *Pinus taiwanensis-Cyclobalanopsis gracilis* forest.

V. Warm temperate coniferous forest

Pinus massoniana forest.

VI. Temperate coniferous forest

Pinus taiwanensis forest.

2. 古田山24hm^{2}森林样地

2.1 样地建设与群落调查

样地植被为典型的中亚热带低海拔常绿阔叶林，位于浙江省古田山国家级自然保护区内，南北宽400m、东西长600m，总面积24 hm^2。2004年11月开始样地建设，2005年9月完成第一次群落调查。样地建设和群落调查参照CTFS（Centre for Tropical Forest Sciences）的方法（http://www.ctfs.si.edu/），用全站仪将样地划分为600个20m × 20m的样方，标定并调查样方内所有胸径（DBH）≥1 cm的木本植物个体，内容包括植物个体的物种名称、胸径、位置等，并挂牌标记。

2. Gutianshan 24-ha forest plot

2.1 Plot Establishment and Plant Census

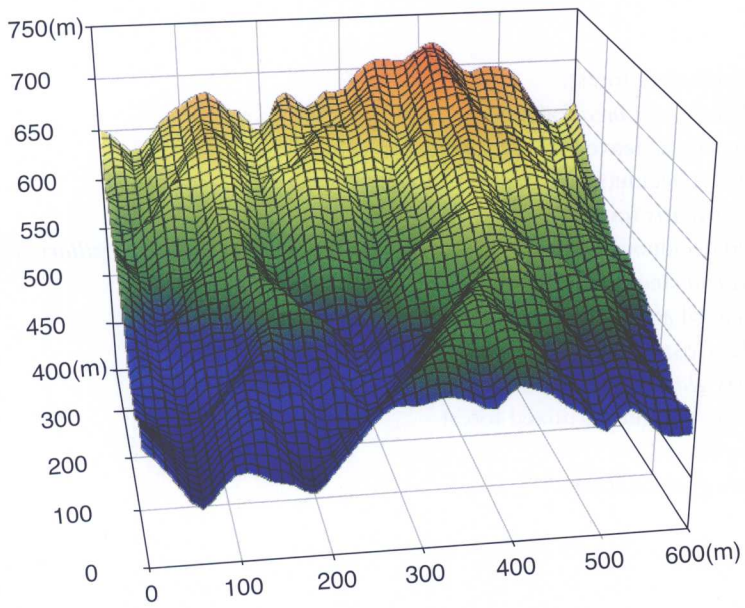
The forests in Gutianshan plot is representative of mid-subtropical evergreen broadleaved forest in Gutianshan National Nature Reserve. Gutianshan plot ranges 600 m from east to west, and 400 m from south to north. According to CTFS's plot census method (http://www.ctfs.si.edu/), the total plot had been grided into 600 20 m × 20 m subplots. All trees with DBH ≥ 1 cm were tagged, identified, measured, and georeferenced, corresponding data such as species, DBH, location data of each tagged tree was recorded.

2.2 地形和土壤

古田山样地地形复杂多变，最高海拔714.9m，最低海拔446.3m，平均海拔580.6m，最大高差268.6m。样地地势较陡，坡度范围12.8°～62°，平均坡度约37.5°。土壤类型主要为红壤，pH值在5.5～6.5之间。

2.2 Topography and Soil

The plot is characterized by rugged terrain: altitude varies from 446.3m to 714.9m above sea level, and the mean elevation is 580.6 m. The mean slope in plot is 37.5° and 20-m cell slope ranges from 12.8° to 62°. Soil type of the plot consists mainly of red soil (equivalent to Ultisols in US soil taxonomy), and the pH value is between 5.5 and 6.5.

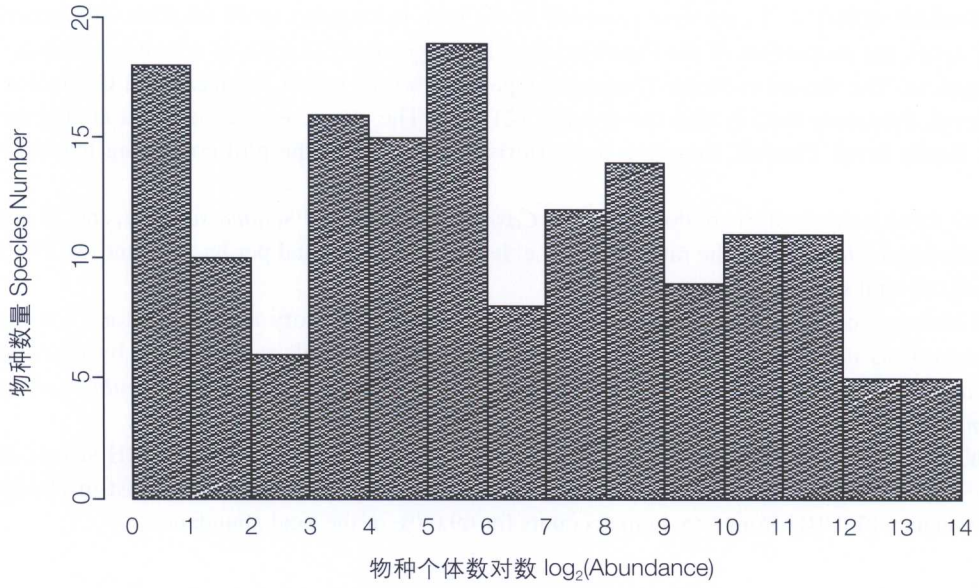


古田山样地三维地形图
Topographical map of Gutianshan plot
样地为长方形，南北宽400m（y轴），东西长600m（x轴）；图中数字为相对高程，
以样地最低点为 0 m。 The plot is a rectangle, horizontal axis is 400m(SN), vertical axis is 600m(EW); the number in the figure is relative height, 0 m is the lowest point.

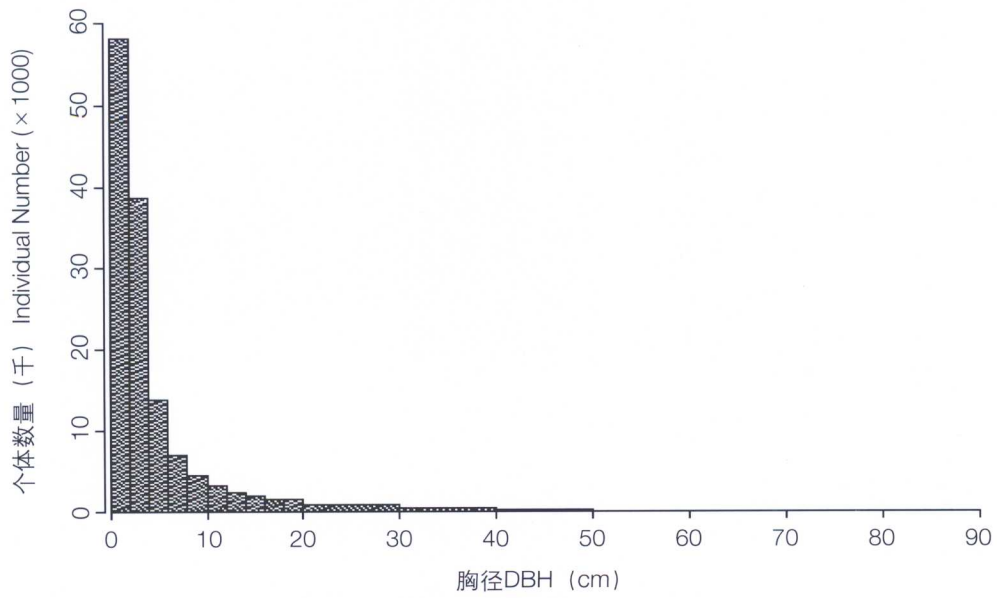
2.3 物种组成与群落结构

样地共有140700个胸径（DBH）≥1 cm的独立的木本植物个体，分属49科，104属，159个种。泛热带科比例最大，为28.6%，代表科为樟科、山茶科和卫矛科；其次为北温带分布科，占20.4%，代表科为壳斗科、山茱萸科。属的类型仍以泛热带分布最多，占到21.8%。种的分布特点与科的分布特点相似。样地的区系组成热带分布类型多于温带分布类型。

样地优势物种明显，以甜槠(*Castanopsis eyrei*)、木荷(*Schima superba*)为主要优势物种，32个物种个体数大于1000；样地内稀有种丰富，59个物种平均每公顷个体数<1，占总物种数的37.1%。



古田山24hm²样地物种－个体数分布图（物种个体数取以2为底的对数）
Species-abundance distribution of Gutianshan 24ha plot (The abundance is log2 transformed)



古田山24hm² 样地胸径≥1cm木本植物个体径级分布图
DBH distribution of individuals with DBH≥1cm in Gutianshan 24 ha plot

样地群落垂直结构清晰，分为乔木层、亚乔木层、灌木层。乔木层以甜槠、木荷、马尾松(*Pinus massoniana*)为优势物种，亚乔木层以枹栎（短柄枹）(*Quercus serrata*)、马银花(*Rhododendron ovatum*)、浙江新木姜子(*Neolitsea aurata* var. *chekiangensis*)为优势物种，灌木层以柳叶蜡梅(*Chimonanthus salicifolius*)、映山红(*Rhododendron simsii*)等为优势物种。

样地内木本植物个体最大胸径为87.4 cm，平均胸径为5.2 cm。样地木本植物个体径级总体呈倒“J”型，小径级个体数量较大，胸径1～4 cm的个体数量占总个体数量的69.07%。

2.3 Species Composition and Community Structure

140,700 individuals (DBH ⩾ 1 cm) were recorded in the plot, belongging to 49 families, 104 genera and 159 species. At family level, the proportion of the Pantropic type is the greatest (28.6%), of which Lauraceae, Theaceae, Celastraceae are typical. The second is North Temperate type (20.4%), of which Fagaceae and Cornaceae are main types. At genus level, Pantropic type is also the greatest (21.8%). The characteristics of flora at species level are similar to that at family level. Overall, there are more floristic elements in the plot consisting tropical type than temperate one.

In the plot, the forest communities are dominated by *Castanopsis eyrei* and *Schima superba*, and 32 species have more than 1000 individuals. *In the plot*, the rare species, i.e. less than 1 individual per ha, account for 37.1% (59 rare species/total species) of total species richness.

The vertical structure of the forest is clear: canopy story, sub-canopy story and shrub story. Canopy story is dominated by *Castanopsis eyrei*, *Schima superba* and *Pinus massoniana*; sub-canopy story by *Quercus serrata*, *Rhododendron ovatum* and *Neolitsea aurata* var. *chekiangensis*; and shrub story by *Chimonanthus salicifolius* and *Rhododendron simsii*.

The maximal DBH is 87.4 cm and the mean value of BDH is 5.2 cm in the plot. The DBH size of individuals in the plot follows the distribution of inverse “J” shape. Small individuals account for the most of abundance. For example, the individuals with DBH from 1 to 4 cm accounts for 69.07% of the total abundance.