

青藏高原横断山区科学考察丛书

横断山区沼泽与泥炭

中国科学院青藏高原综合科学考察队



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THE SERIES OF THE SCIENTIFIC EXPEDITION TO HENGDUAN
MOUNTAINS, QINGHAI-XIZANG PLATEAU

**THE MIRE AND PEATLAND OF
THE HENGDUAN MOUNTAINS REGIAN**

The Comprehensive Scientific Expedition to the
Qinghai-Zizang Plateau, Chinese Academy of Sciences

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内容简介

本书是中国科学院青藏高原综合科学考察队沼泽与泥炭专业组经过多年艰苦考察后总结完成的一部专著,是涉及横断山全区的第一部沼泽泥炭学术著作。本书对该区沼泽与泥炭的空间分布规律、基本类型、形成环境、发育模式及沼泽生态系统等重要方面都进行了较深入的分析,建树了许多新观点和新概念。本书还对研究区沼泽与泥炭的资源评价、开发利用与保护等应用性问题进行了全面论述。本书包含大量的科学数据和资料,对横断山区这样一个独特的地区来说,这是十分珍贵的。

本书可供沼泽与泥炭研究的专业人员以及地学和生物学界广大科技人员及高等院校师生参考。

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《青藏高原横断山区科学考察丛书》序

辽阔的青藏高原,包括西藏全部、青海南部,以及四川西部和云南西北部。大部分地区海拔在4000米以上,四面以巨大的落差急剧下降,衬托出世界屋脊的磅礴气势,素有世界第三极之称。由于青藏高原独特的地质历史和自然条件,丰富的生物组成和生物群落类型,成为地球上一个独具特色的地理单元。青藏高原蕴藏着丰富的自然资源,又是许多少数民族生活和居住的地区,且地处边陲,合理保护和开发这一地区的自然资源,对发展经济,改善人民生活,以及巩固民族团结和加强国防建设都有重要的意义。

为了探索青藏高原形成和演变的历史,研究自然条件的特点及其对周围环境的影响,研究自然资源的数量和质量及其合理开发利用的途径,解放以后,中国科学院对这里进行了多次科学考察,特别是自1973年起组织了青藏高原综合科学考察队,对这一地区进行了更为全面、系统的综合性研究。

1973—1980年期间,考察队重点对西藏自治区进行了考察。其科学成果将集中反映在陆续出版的《青藏高原科学考察丛书》(西藏部分)及论文集和画册中,有些成果在实际生产中已得到推广和应用,在国际和国内产生了深远的影响。

考察队从1981年起将考察研究的重点转移到横断山区。横断山地处我国西南的藏东、川西和滇西北一带,是青藏高原的一个组成部分。在行政区域上包括西藏自治区的昌都地区,四川省阿坝、甘孜、凉山等州及云南省丽江、迪庆、怒江和大理等地(州)区,总面积约50万平方公里。

横断山脉在地质构造上处于南亚大陆与欧亚大陆镶嵌交接带的东翼,是我国东部环太平洋与西部古地中海带间的过渡地带。地质构造复杂,新构造运动活跃。本区地势由西北向东南倾斜,大部为高山峡谷,山脉、河流南北纵贯,相间并列,高差很大,自然地理条件独具一格,生物区系绚丽多彩,且富含古老和孑遗类型,是研究生物和地学中许多重大理论问题的关键性地区。

横断山脉自然资源丰富,尤以多种矿产、水、森林、草场等资源最为丰富。但是随着人口的增长和开发利用的加剧,自然资源承受的人类压力日益加大,有些地区生态平衡遭到了破坏。为了合理利用自然资源,必须研究本区的自然资源特点,探索其合理保护利用与开发的方向和途径。

横断山区科学考察工作主要围绕六个课题进行:(1)横断山脉形成的原因和地质历史;(2)横断山区自然地理特征及其与高原隆起的关系;(3)横断山区自然垂直地带的结构及其规律;(4)横断山区生物区系的组成;(5)横断山区自然保护与自然保护区;(6)横断山区自然资源的评价及其合理开发利用。

为了使科学考察研究更密切地与当地的经济开发工作结合起来,在自然资源评价与开发利用方面着重抓了农业自然资源条件与自然资源系列制图;亚高山暗针叶林采伐与更新;地方能源的综合利用;畜牧业发展战略及干旱河谷农业自然条件与开发利用等五项综合专

题的考察研究。

横断山区的综合科学考察研究工作由中国科学院—国家计委自然资源综合考察委员会负责组织领导。参加此次考察研究的包括中国科学院有关研究所、高等院校和地方科研与生产部门等单位计 40 余个,约 300 多人,涉及 40 多个专业。

《青藏高原横断山区科学考察丛书》将系统地总结青藏高原综合科学考察第二阶段的成果。

《青藏高原横断山区科学考察丛书》由横断山区农业自然条件与农业自然资源评价、四川省金川县农业自然条件与农业自然资源评价、横断山区的地方能源资源、横断山区亚高山暗针叶林采伐与更新的研究、横断山区(川西部分)畜牧业发展战略的研究、横断山区干旱河谷的环境条件与农业资源的开发利用、横断山区地质构造、横断山区的沉积岩及沉积盆地演化、横断山区基性超基性岩、横断山区富碱侵入岩带地球化学和成矿、横断山区花岗岩类地球化学、横断山区锡矿带地球化学、横断山区地层、横断山区古生物、横断山区哺乳动物化石与生活环境、横断山区地热与水热活动区名录、腾冲地热、横断山区自然地理、横断山区地貌与第四纪地质、横断山区草场、横断山区植被、横断山区沼泽与泥炭、横断山区湖泊综合研究、横断山区中小河流及水资源、横断山区自然垂直带结构特征及分布规律、横断山区植物、横断山区家畜种群生态、横断山区鱼类、横断山区哺乳动物、横断山区鸟类、横断山区两栖爬行动物、横断山区甲壳动物、横断山区昆虫、横断山区土地资源开发与农业布局等专著组成。我们希望它能在探索青藏高原的奥秘和我国社会主义建设中发挥积极的作用。

中国科学院青藏高原综合科学考察队

THE SERIES OF THE SCIENTIFIC EXPEDITION TO THE HENGDUAN MOUNTAINS OF THE QINGHAL-XIZANG PLATEAU

PREFACE

The vast Qinghai-Xizang Plateau, consisting of the Xizang (Tibet) Autonomous Region, the southern part of Qinghai, western part of Sichuan and northwestern part of Yunnan Provinces, is often eulogized as the third polar of the world. The major parts of the Plateau are 4,000 metres above sea level, while the areas around drop drastically setting off the tremendous momentum of the roof of the world. The particularities of the geological history and physical conditions, the variety of biological composition and the different types of bio-communities make the Qinghai-Xizang Plateau a unique geographical unit. As the Plateau, being rich in natural resources, lies on the border regions where inhabit many national minorities, their rational conservation and utilization of the natural resources in this region are of particular importance in developing economy, improving the local livelihood and consolidating national solidarity as well as strengthening national defence.

Ever since the foundation of new China, many scientific surveys have been carried out in this region so as to make a better understanding of the history of the formation and evolution of the Qinghai-Xizang Plateau, to study the characteristics of its natural conditions, their effects on the environment around and the quantity and quality of the natural resources and thus, to find a way of exploiting and utilizing them rationally. Especially after the forming of the Comprehensive Scientific Expedition to the Qinghai-Xizang Plateau in 1973, an even more comprehensive systematic integrated research has been made on this region.

A survey was mainly carried out on the Xizang (Tibet) Autonomous Region during the period of 1973—1980. The scientific findings of the survey, part of which have already been extended and applied to actual production and have brought a far-reaching influence both in and outside China, will be concentratedly compiled in the series of the scientific expedition to the Qinghai-Xizang Plateau (Xizang Volume), Proceedings and pictorials. Since 1981, the survey team has

shifted its major researching area to the Hengduan Mountains Region which is a constitutional part of the Qinghai-Xizang Plateau and is located in the east of Xizang, west of Sichuan and northwest of Yunnan Provinces in southwest China. The total area of this region is about 0.5 million square kilometres and administratively speaking including the Qamdo district of Xizang, Erba, Cangzi, Liangshan of Sichuan and the Lijiang Nujing and Dali districts of Yunnan.

The Hengduan Range is complicated in geological structure and active in new tectonic movements. It lies on the east flank of the juncture area where south Asia and Eurasia are mounted. It is the transition region between the east zones encircling the Pacific and the west zones of ancient mediterranean. The altitude of this area declines from northwest to southeast. Most parts of the area are characterised by a series of paralleled mountain ranges and rivers from south to north, and with a sharp altitudinal differentiation. Its unique physical conditions and variety ecosystems being rich in flora and fauna with abundant relic species, give the area a critical nature for the fundamental research in the field of biology and earth science.

The Hengduan Mountains Region is abundant in natural resources, among which multi-mineral products, hydrological resources, forest and grasslands account for the great part. But with fast growth of the population and an extensive exploitation and utilization of the natural resources, the human pressure on natural resources has vastly increased which even caused ecologic equilibrium damage in some part of the area. In order to make a more reasonable utilization of natural resources, it is necessary to study the characteristics of the resources in this region so as to work out certain ways and methods for protecting, utilizing and exploiting them rationally.

There are six major subjects in the research work being carried out in the Hengduan Mountains:

1. The geological history of the Hengduan Range;
2. The physiographical characteristics of the Hengduan Mountains and their relationship with the rise of the Plateau;
3. The structure and rule of the altitudinal belts of the Hengduan Mountains;
4. The composition of bio-communities in the Hengduan Mountains;
5. The natural conservation and nature reserves in the Hengduan Mountains;
6. Evaluation of the natural resources in the Hengduan Mountains and their rational development and conservation.

Five intergrated projects have also been given special attention in the research on natural resources evaluation, exploitation and utilization. They include as following: compilation of a series of maps on the conditions of agricultural resources; deforestation and regeneration of subalpine coniferous forest in subalpine areas; the multiple utilization of local energy resources; strategy for the development of animal husbandry and finally the management of the natural resources in the arid valleys. This has been done in line with the purpose of linking scientific research closely to the development of the local economy.

The intergrated survey on the Hengduan Mountains Region is organized by the Commission for Integrated Survey of Natural Resources, Chinese Academy of Sciences and the State Planning Commission. There are more than 300 people, coming from more than 40 institutions including different institutes of the Chinese Academy of Sciences, universities and local scientific research and production departments engaged in natural resources research. A series of scientific publications on the Hengduan Mountains will provide the results acquired from the second phase of the integrated scientific survey in the Qinghai-Xizang Plateau. It is designed that this series will be consisted of 39 volumes and 48 monographs. It is also expected that this series will play an important role in exploring the wonders of the Qighai-Xizang Plateau and in the construction of China.

The Comprehensive Scientific Expedition
to the Qinghai-Xizang Plateau,
Chinese Academy of Sciences

前 言

横断山区属于青藏高原的一部分,地处藏东、川西、甘南和滇西北的接壤地带,总面积约 50 万平方公里。

横断山区素以高山峡谷汇聚,河流南北纵贯,险峰兀立,山川并列的地貌景观称著于世。为寻找长江正源,揭开腾冲火山群之谜,伟大的地理学先驱徐霞客曾数度来此探险。这块神秘的土地不仅自然景观独特,而且自然资源丰富,有地球上最完整的自然垂直带谱和复杂多样的生态系统,历来为中外科学工作者所瞩目。自然,这种特殊的地理环境也蕴育了类型独特的沼泽和泥炭,其形成不仅受沼泽、泥炭发育的一般规律所支配,也受区域性特殊的发育条件所制约。因此可以说,人类对这一地区沼泽和泥炭如果缺乏科学认识,就谈不上真正了解地球上的沼泽和湿地。

我国的沼泽、泥炭研究起步较晚,但在 60 年代初,我国科学工作者即开始了对横断山区东北部若尔盖高原沼泽与泥炭的研究,至今仍在继续,成为我国沼泽与泥炭研究程度较高的地区,但横断山区的其他部分却长期处于空白状态。自 1981—1985 年,随着中国科学院青藏高原综合科学考察队对此区展开大规模调查,我们沼泽、泥炭专业组,对此区进行了历时 5 年的综合调查,野外考察路线纵横整个横断山地。这支由中国科学院长春地理研究所、四川省自然资源研究所和四川省草原研究所共 15 人组成的多学科沼泽、泥炭考察组,不仅包括一般沼泽考察的地质、地貌、气候、水文、沼泽植被和沼泽土壤专业,而且还包括泥炭第四纪和沼泽动物专业人员。沼泽动物还从资源动物角度进行研究。因此,这次对本区沼泽、泥炭的考察其范围之广,持续时间之长,所含专业之多,是前所未有的。

本书系这次大规模考察研究的总结,计十一章,50 余万字。其中第一章阐述了区域沼泽与泥炭研究历史,对沼泽概念的认识,以及沼泽和泥炭形成的自然环境。作者建议的沼泽概念是:沼泽是地球表层独立的地理综合体,地表过湿或积水,生长沼—湿生(或盐生)植物的复合生态系统。本章还指出黄河古河道是若尔盖高原沼泽发育的重要因素。第二章重点叙述沼泽类型,共分为 2 类 5 型 30 体。在此基础上总结出 4 种沼泽发育模式,并对湖泊沼泽化提出了新见解。第三章分析了本区沼泽与泥炭的空间分布规律,提出沼泽分布具有三维层性,只不过表现特点不同。由于地貌与气候的控制,区内沼泽与泥炭表现出区域差异性,并由此建立了分区。第四章论述了该考察区的气候和水文特征,指出区内水文具有明显的不均衡性,而不同地区的气候受控因子亦异,造成了沼泽与泥炭的区域差异。第五章论述了沼泽植被的分布、区系组成和类型。划分为 7 种地理成分,1 个植被型、2 个亚型、5 个群系组和 23 个群系。第六章指出了沼泽动物具有食物网简单等 6 个特性,并具有种群结构随沼泽类型而异的特点。沼泽动物有锐减趋势,极须保护。第七章对横断山区三类基本沼泽生态系统,指出其第 1 性生产力差异很大,食物网也复杂多样,碳循环处于积极正平衡态。第八章划分了泥炭与泥炭地类型,共划出 3 个型 3 个类和 3 个亚类。根据作者建立的分类原则,将泥炭地分为湖盆泥炭地等 10 个系列,20 个类型。第九章分析了泥炭的理化性质,

本区泥炭具有含水量大,分解度低,裸露面积广等特点。剖面中非生命元素变化大,有机质含量偏低,纤维含量高。第十章探讨了泥炭地的环境变化,全新世泥炭划为5个发育阶段,以中全新世发育最快。在云南湖区泥炭有更新世与全新世连续沉积现象。第十一章对全区泥炭资源进行评价,并提出了开发利用的原则和生态环境保护措施。

科学考察队员长期活动在人迹罕至的原始沼泽和高原上,爬过6000米左右的高山十余座,多次进入无人区。在高寒缺氧的环境里,饥吞糟粃,渴饮沼泽水,甚至几次发生生命危险,但我们的专业组5年跋涉2万多公里,终于征服了横断山。可以无愧地说,本书所容纳的科学资料不仅仅是用汗水,也可以说是以生命做代价换来的。大家将十分留恋在野外精诚团结,通力协作,同生死共患难的日日夜夜。我们也不会忘记参加过考察工作而未能共同写作的凌作培、索荣、李贵禄、李蓬来、李越、鲍强、邓伟、王文治同志,以及司机刘光荣、梁立军、周晓枫、路川、王同军、王树林等师傅。在考察中,我们不仅得到本队的大力支持,而且得到川、滇、甘、青四省区政府和地方干部及各族群众的有力配合,他们或予食宿,或充向导,为完成科学考察提供了保证。

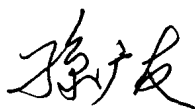
本书的写作分工是:前言、第一、二、七、八、十、十一各章由孙广友执笔;第三、四、九章由张文芬执笔;第五章由杨福明、易富科、赵魁义执笔;第六章由张家驹、罗佳等执笔;全书由孙广友(兼主编)统稿并与张文芬(兼副主编)和张家驹(兼副主编)共同校审。

在室内承担化验分析工作的同志有汪佩芳、夏玉梅、王曼华、郑萱凤、李崇玲、陈炳文、陈雷、张爱新、淳于树菊、蔡省垣、赵秀明、李汉鼎、冷雪天。为本书绘制图件的有朴珠玉、杨慧媛、宋泽霞等同志,范春光、陈觉婷、於北、于宗波、华润葵等同志在计算机及遥感方面给予大力支持。没有他们的协助,本书也是难以完成的。在回首考察历程,并将此书奉献于社会之时,谨向他们及所有帮助过我们的同志致以衷心谢意。

本书承蒙黄锡畴研究员审阅编写提纲,陈鹏和郎惠卿教授审阅部分章节,对本书水平提高大有裨益,在此同申衷心谢忱。

作者还特别感谢中国科学院自然资源综合考察委员会和中国科学院长春地理研究所在本书出版中给予的经费支持;本书责任编辑科学出版社刘卓澄先生,为使本书更致完善,精心设计和校审,付出了大量心血。

本书虽经多年调查写成,然横断山区毕竟土地博大,交通险阻,再加作者水平有限,疏漏、错讹之处难免,敬请读者批评指正。



志与长春

1997年12月2日

PREFACE

The Hengduan Mountains Region is located in the area of East Xizang, West Sichuan, South Gansu and Northwest Yunnan Province, a part of Qinghai-Xizang Plateau with a total area of about $5 \times 10^5 \text{ km}^2$.

This engrossing region is famous in the world for its geomorphological landscapes such as high mountains and deep gorges, rivers pass parallelly from north to south. Xu Xiake, a great forerunner—ancient geographer of China, made several explorations here in order to find the main source of the Yangtsi River and discover the secrecy of the Tengchong Volcano Group.

Chinese scientists began the studies on mire and peatland in the region is relatively later than other study field. But since 1960s, they have been doing a lot study in the Northeast Hengduan Mountains—Ruorgai Plateau, and also have made it a region with higher on research level in our country. The other parts of Hengduan Mountains region has still been the gap. From 1981 to 1985, with the large scale research in this region by the Comprehensive Scientific Expedition Team of Chinese Academy of Sciences. We, as a branch team of swamp and peat, comprehensively surveyed this region. The team was consisted of 15 members that come from Changchun Institute of Geography, Chinese Academy of Sciences, the Institute of Natural Resources of Sichuan Province, and the Institute of the Grass of Sichuan Province, in which included the specialists of geology, geomorphology, Quaternary, climate, hydrology, swamp plant, swamp soil and swamp animal. In the region, the specialize on swamp animal was the first time of swamp investigation in China since 1949.

This book which has 11 chapters about 500,000 words, is the summary of this comprehensive survey, The chapter 1 expressed the research history of the region in swamp and peat, swamp concept, and the natural environment in the region.

The chapter 2 focus on the types of the swamp, it is divided into 2 types, 16 classes, 30 bodies, and presented 4 models of swamp.

The chapter 3 discussed the distribution law of swamp which has 3 dimensions and only showed difference in regional character, because of being controlled by geomorphology and climate factors. swamp and peat were divided into different areas.

The chapter 4 analysed the character of climate and hydrology in this region and pointed out that the hydrology has clear disequilibrium, and the factor of control climate is different in different regions, so formed regional difference of the swamp and peat.

The chapter 5 outlined the distribution of swamp plants, its system and types, and divided into 7 areas, 1 type and 2 subtypes, 5 group systems and 23 groups.

The chapter 6 pointed 6 features including the simple food web of the swamp animals and its structure is depended the swamp types. The swamp animals should be protected because they are being lost on speedily.

The chapter 7 analysed 3 basic swamp ecosystems in the region. The primary productivity is very different from high to low and the food web is also complex. The carbon circulation is on actively positive balance.

The chapter 8 divided the peatland and peat into 3 types, 3 subtypes and 3 classes. According to the classification principle, the peatland was divided into 10 peatland systems, such as Lake-Basin peatlands etc., and 20 types.

The chapter 9 analysed the physical and chemical characters of peat and swamp. The water content of peat is very high, decomposition is low and the area of uncovered peat is large. In profiles, we can see that the non-life elements changed largely and the organic matter is lower but the fibre is high.

The chapter 10 discussed the environmental change of peatland. The development of Holocene peat is divided into 5 stages and Middle Holocene period is the most active one. There are continuous deposit phenomenon in Yunan basin of lake.

The chapter 11 appraised the peat resources in the whole region and made out principles and measurements on the resources utilization law and environment and resource protect.

The scientific explores have worked in the bleak swamps and the plateau, climbed up the more than 10 mountains where about 6000m and often went into non-human regions. In these dangerous regions, it is often to have not food and even suffered from life danger. We have overcome the Hengduan Mountains region and have crossed more 20000 kilometres in five years. It can be said that the data in the book are exchanged by sweat and life.

We will never forget the days that we spent together, We will also remember our colleagues who have taken part in exploring but have not written in the book, such as Mr. Ling Zuebei, Li Gueilu, She Run, Li Penglai, Li Yue, Bao Chang,

Deng Wei and Wang Wenzhe, bus drivers Liu Guangrun Liang Lijun, Zhou Xiaofeng, Lu Chang, Wang Tunjun and Wang Shulin, In the explores we are not only supported from Chinese Academy of Sciences, but also get great help from the Sichang, Yuanan, Ganshu, and Qinghai province goverments and people as well. They gave us accomandation or served as guides.

We also thanks for our colleagues Wang Peitang, Wang Manhua, Xia Yumei, Zhang Yuangzen, Zhang Aixin, Chun Yu, Chai Shengyuang, Zao Xiuming Li Handing Leng Xuetiang Li chunling, Chen Bingwen, Chen Lei etc, who have analysed the samples, and Piao Zuyu, Yang Hueiyuang and Song Zhexia etc, who have traed the mapes in the book. Hua RenKuei, Yu Zunbe Fan Chunguang, Chang Jueting and Yu Bei etc. who give us help in the remote sensing and caculater of computer. If without their help, the book can not be finished so sucessfully. And we also thank for all people who have helped us.

The authors of every chapter are: The preface, chapter 1, 2, 7, 8, 10 and 11 by Sun Guangyou; Chapter 3, 4 and 9 by Zhang wenfen; Chapter 5 by Yang Fuming, Yi Fuke and Zao Kweiyi; Chapter 6 by Zhang Jiaju and Luoia; We also thank for professor Huang Xichou, who examined the outline of the book, professor Chang Pn and Lang Hueiqing examined chapter 5 and 6.

Though the book is finished for many years, the Hengduan Mountains region is such a large and cold place, and also that our limited knowledge. It is that there some wrongs or inappropriations in the book. The readers are welcome to critictive it.

Editor-in-Chief

Sun Guangyou



Dec. 2, 1997