

中国麝科动物



THE MUSK DEER
IN
CHINA

盛和林 刘志霄 主著

上海科学技术出版社

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内 容 提 要

本书是关于中国麝类动物研究的专著,内容涉及麝的基础生物学、种群生态学、人工养殖与活体取香、麝香药理及临床应用、麝资源保护和利用等诸多方面。它不仅概括了我国近半个世纪以来有关麝科动物研究的文献资料,对麝的研究成果进行了系统总结,而且更重要的在于,它是作者近二十多年来对麝资源保护与研究辛勤实践的结晶。书中,特别在林麝的足趾结构与上树习性、麝的分类、繁育、种群特征、资源衰退的原因及保护策略等方面,提供了新的资料与论述,对于前人的一些观点也进行了新的思考,提出了新的见解。

本书可供动物学、生态学、医药学、经济动物养殖,以及保护生物学等领域的科研人员、教师和研究生参考,对于野生动物爱好者也有参考裨益。



本书著者

主 著 盛和林 刘志霄

著作者 盛和林 刘志霄 徐正强

郑汉臣 黄 骥 叶愈青



序 一

野生动物是我国自然生态系统的重要组成部分,关系到国民经济、社会可持续发展,以及人与自然的和谐,特别是珍贵稀有、濒临灭绝的野生动物,更是存在亟待研究解决的问题。当前的问题是,尽管国家颁布了野生动物保护法和相关的条例,但乱捕滥猎滥吃野生动物的现象屡禁不止,应引起政府主管部门和各级领导进一步的关心与重视,野生动物的保护工作仍然相当繁重。

本书是作者对麝持续 20 年研究后完成的专著,其特点是理论研究与应用相结合,野外调查与围养试验并举;风格是深入一线实干;宗旨是积极保护、合理利用,提出保护的第一目标是拯救物种,第二目标是在种群恢复的基础上边保护边利用的观点。该书涉及麝的生物学、分类、生态、养殖、麝香及麝香药,以及麝资源兴衰的原因和保护。全书富有新意,一些独特彩照也为之添彩。

我有幸结识本书的作者盛和林教授。我们从事的工作不同,但是二十多年来的相识、相知以及共同的理念,使我们成为挚友。这本书的出版,经历了曲折的道路,作者历尽艰辛,坚持不懈,直到耄耋之年,终于付梓问世,实属不易。我对作者和参与并支持这项工作的同志们,亦表由衷敬佩。我相信,读者阅读这本书,一定会增长知识,增强保护野生动物的意识和责任感,一定会有新的启迪和帮助。应作者之邀,写了上面一些感想,表示对此书出版的祝贺。



2006 年 3 月 31 日

| Preface 1

Wildlife is a vital component of the Chinese ecosystem; its conservation is consequently one of the key issues in sustainable development in China. Yet wildlife in China is still suffering under enormous pressures of hunting activity and habitats deterioration, even though wildlife conservation has been legislated in both state and provincial people's congresses. It is one of the most important challenges for both government and community in China to strengthen wildlife conservation and protect wildlife effectively.

What this monograph presents to readers is the conclusions from the scientific research undertaken by the author over last 20 years. The monograph covers the issues of the musk deer's ecology, classification, farming and conservation, focusing on the restoration of the wild musk deer population as well as sustainable use of the domestic resource. The author's conclusions are supported by an enormous amount of data from field investigations and laboratory research as well as from the study of captive stock, and the inclusion of pictures enhance its readability.

The author, Professor Sheng Helin, has been one of my closest friends over the last 20 years, during which we have shared a vision for wildlife conservation although we have worked in different fields. As I understand it, Prof. Sheng has experienced extreme difficulty during the course of writing his monograph; its final publication will be a source of great satisfaction both to him personally and to all his colleagues who have supported his work. Not only will this book increase readers' understanding of musk deer ecology, but I am very sure that it will promote wider awareness of conservation.

Dong Zhiyong

2006.3.31

我与和林教授相识,始于20世纪50年代。1956年,我们在东北师范大学的动物生态学研究班同室学习,野外工作,又在同一个小组内一起研究吉林市的鸟类区系。以后,我又参加了他主编的《脊椎动物野外实习指导》和《中国鹿类动物》的编写。经常切磋学问,也加深了友谊。

这本书,正如他自己所说,是早有设想、有计划、有步骤、积20多年之血汗,下了血本的!不错,这是一本关于麝的学术专著,可这也是一部现代动物学家毕生战斗的诗史啊!

我认为,这本书最大的特点是其创新性,无论是原始创新,或者是组装创新和改进创新,书中均有所体现。他多年来在麝的宏观生态调查基础上,结合人工饲养对麝进行了一系列的生态生物学研究;将圈养种群、岛屿放养种群的行为生态学研究与兴隆山自然保护区自然种群的种群生态学研究相结合,为动物行为生态学的研究提供了新思路;他很重视动物行为和结构功能关系的研究,如麝能上树并能在树枝间活动,这在有蹄类动物中是极为罕见的行为,书中详细记述了麝足的适应性结构。在科学研究中,他那种讲究认真,“事必躬亲”亲自动手实干的精神令人难忘。当年在长春野外,我们曾经赞扬过前苏联专家库加金教授工作认真、亲自布放和检查鼠夹、亲自动手挖鼠洞的实干精神。今天,我们看到了这种实干精神的历史传承。实践出智慧。书中记载的很多是他亲自看到的并亲自干的研究成果。其次,他那“不耻下问”虚心学习的精神,也值得称道,向实践者学习,同时他把自己的学生派往国外,学习先进的东西,既培养了人才,也提高了学术水平。大家知道,学习是创新的基础,虚心学习的第二步就是创新。再次,书中进行了多学科의 组装,增添了麝香的鉴别和药理研究,这便使麝和人类社会生产、生活直接联系了起来。过去我们许多专著对动物产品研究关注很不够,抑或有经济价值的标题,在内容上也只是简单的“肉可食”、“皮可用”等叙述,实际上这是一个十分广阔的科学的、文化的研究领域。书中设有专章讨论麝香

是正确的。特别应指出的是,麝资源的保护和利用在我国是个大问题,书中设专章进行了讨论,提出不少有创意的见解和建议,这对我国今后麝资源的保护和管理很有裨益。总之,本书的科学性、系统性均很强,不仅是作者数十年的心血结晶,也是现代单种或一类动物专著的时代范本,相信这本专著的出版对我国麝的保护和研究必将起到积极的促进作用。

A handwritten signature in black ink, appearing to read '马红' (Ma Hong), written in a cursive style.

2006年5月16日

Preface 2

Professor Sheng Helin has been one of my closest friends since the 1950's. I still remember how, in 1956, we studied together in the Zoological Research Program of North East China Normal University as postgraduates, and both of us participated in a research group to study bird distribution in Jilin. And later, I was invited to participate in the writing team of his books titled "Field Study Manual of Vertebrates" and "Deer of China" as co-author. Frequent academic cooperation and shared experiences have continually increased the friendship between us.

I am very pleased to write the Foreword of this book for Prof. Sheng. As he writes, this book concludes his 20 years' study, guided by a long and detailed plan. The resulting monograph of China's musk deer reflects his image as one of the most outstanding zoologists in China.

I believe that one of the most important features of this book is the breadth of his inspiration, reflecting Prof. Sheng's unique ideas. Comparing his field study on wild populations of musk deer on some islands and in Xingrong Reserve with his study of the domestic population, he has developed some new theories of the animals' behavior ecology. He explains behaviors related to the function "scenically", so to speak; for instance, their behavior of climbing trees — a new discovery — led him to describe the evolutionary adaptation of the foot structure in detail.

Prof. Sheng is always happy to work by himself in his scientific research. In our early days, working and studying in Changchun (North East China), both of us admired our teacher, a Russian Professor, Dr. Kim, who worked so hard in the field, and did field work in front of us or any of our students. Today I can detect the image of Dr. Kim behind of Prof. Sheng in this book: practice and learning access to the truth. Prof. Sheng is a person who loves to learn from other people, including his students. He has sent a number of his students overseas for further study; he considers sound training as one of his most important missions as a teacher.

In his book, Prof. Sheng details the medical analysis of musk rather than simply describing the musk deer as meat or as Chinese medicine, as is usually done when talking about their economic function in other books. This book devotes a special chapter to discussion of musk deer preservation and sustainable-use, in particular raising some important questions on protection and management viewed in the light of scientific and cultural research. I believe Prof. Sheng's work should do much to promote future research, and the conservation of musk deer in China.

Ma yiqing

2006.5.16

麝(*Moschus*),是我国兽类中经济价值和社会价值极高的资源动物。雄麝的麝香腺分泌物——麝香,是带有神秘色彩的中药。其疗效显著,无毒副作用,并且香气浓郁、散射而持久,也深受香料工业的偏爱,因而备受国内外学者和民众的广泛关注。麝香在我国医药还不甚发达的历史时期,被视为救命药,曾拯救过无数百姓的生命。中国人都知道麝香的神奇作用。麝香的市场价格历来与黄金相当,至20世纪70~80年代,因供需矛盾突出,国外不法商人不断提价,以至数倍于金价,也由于麝香身价倍增,偷猎走私日益猖獗,从此麝即遭到灭顶之灾,至90年代已临枯竭。麝是一类孤独而隐蔽的动物,人们对它知之甚少,至今一些中药师还在流传:“麝香是麝在张开香囊晒太阳时,引诱昆虫钻进囊内后,突然关闭形成”的传说。当然很多人还从未见过麝,因为这类胆小动物怕见人,连动物园内也难训育展出。

作者从事研究的理念是:人生时间和精力有限,只有面对最有价值的研究对象,更能体现自我价值。因此,一向重视选择价值高的研究对象,考虑到麝香对我国中医药业的作用和影响。早在20世纪60年代便产生了探索麝奥秘的愿望,但当时并不具备研究麝的客观条件,只能从投入少的课题开始。研究始于鸟类,60年代初转向农田鼠害的防治;继而对年出口一二百万张毛皮的黄鼬的生态与资源利用进行研究;70年代末开始研究年猎取量超过百万头的小型鹿类(獐、麂、毛冠鹿等)的生态、保护和驯养,这为开展麝的研究奠定了基础;1980年尝试向中国药材公司提出研究麝的申请而未获准,1981年,作者有幸认识时任林业部副部长的董智勇和保护司副司长的卿建华同志,向他们陈述了保护和研究麝的迫切性和研究意向,受到他们的鼓励和支持。他们对野生动物保护事业的科学观、责任心和乐意倾听学者心声及秉公办事的作风,深受作者及众多学者的尊敬。1982年春,麝研究课题正式立项,并很快获得资助,从而使麝的研究得以启航,实现了作者的梦想。因此,本书的出版是与这两位前领导给予的支持分不开的,在此深表敬意和致谢!

研究项目的主题是保护和利用,宗旨是为物种生存、繁荣和中药需求而保

护,重点是异地驯养和自然种群的研究。异地驯养,一是为扩大饲养区域,获取药用麝香,以减少对野生麝的捕猎;二是可将饲养种群的后代重返已绝迹或新的分布区,加快种群恢复。异地驯养的限制因素不是食物,而是夏季高温。所以引种选址于浙江舟山夏季气温较低的有林海岛,且有海水作为天然屏障,利于驯养和放养。驯养地从舟山过渡到浙江西天目山、上海崇明岛,最后转移至上海。实践证明在上述地区,麝不仅能成活,而且能正常繁衍,正常泌香,上海崇明岛及市区的饲养种群已延续至今。虽然上海不是养麝的理想环境,但表明异地驯养是成功的。在驯养研究的同时,进行了放养实验,先后在舟山的摘箬山岛、普陀山岛和金钵盂岛探索性的试放,结果令人失望,或被家犬咬死,或被偷猎;在普陀山岛放养的3头,不到一个月便全军覆灭,仅金钵盂岛的麝生存了两年多,放养试验以失败告终,深刻的教训是:在没有能力管理和控制偷猎的条件下,放养是行不通的。

作者并不认为在近一二十年内通过大规模饲养能解决麝香药源,因而倾向于通过保护自然种群来缓解。为此,期望能找到一个较为封闭、又能有效控制的研究基地,曾去安徽、四川等地考察过一些地方,可许多地方已难见麝的踪影,条件稍好的四川省青川县唐家河川河自然保护区,迁出了保护区内全部居民,当时还有一定数量的林麝,但保护区仅以大山山脊为界,麝可任意出入,无法满足对种群消长的研究条件。对麝的保护措施也不理想,没有保障。直到1991年夏,在开门就是山的甘肃兴隆山自然保护区内,上山仅一个多小时便发现不少麝的粪堆,且能经常见到麝的活动,实在令人振奋。作者多年的野外调查从未遇见如此丰富的麝资源和如此理想的自然条件(一个被广阔黄土秃岭和农田完全隔离的“林岛”),且管理又如此有效的自然保护区。这是作者寻找多年来最理想的研究基地(应感谢张洁研究员提供的信息)。为了探索麝自然种群及其数量消长规律,为保护和利用寻求依据,在未能得到国家林业局继任主管的理解和支持的情况下,不得不自筹资金,从1993年起,带领几位研究生,与保护区管理局开展合作研究,获得大量数据,并做了几件实事:(1)将区内林麝名纠正为高山麝(马

麝);(2) 查明了区内麝的数量的年波动在 3 500~5 000 头;(3) 为保护区培训了野外调查的技术骨干,提供技术指导;(4) 协助保护区申请立项,继续研究。直至 2002 年,笔者和研究生先后前往 9 次,其间和博士生刘志霄一起又研究了景泰县的寿鹿山自然保护区(包括四个林岛),以及被大沙漠隔离的贺兰山自然保护区内的高山麝。为此,重视野生麝种群生态的调查。通过对四川和大别山林麝的调查,特别对甘肃省内的兴隆山和寿鹿山,宁夏和内蒙古自治区的贺兰山高山麝的多年研究,二十年野外调查积累的大量资料和饲养实践,是编写本书的基础。

在调查和资料积累过程中,得到我的同事和研究生以及各地方林业部门的帮助,特此致谢!

麝的系列研究经费,林业部于 1982 年给予最关键的资助,后续资金得到国家教委博士点基金、上海市科委、上海市药材公司的资助,以及日本环境保护协会的资助和与日本北海道大学合作研究经费。在研究过程中得到四川省林业厅、川西林业局养麝场、甘孜州林业局、青川县唐家河自然保护区;甘肃省林业厅、祁连山自然保护区、榆中县兴隆山自然保护区、景泰县寿鹿山自然保护区;宁夏和内蒙古自治区贺兰山自然保护区;安徽省林业厅;浙江省舟山市科委和科协;上海市农林局等单位在引种、调查研究和试验场地等方面的鼎力支持。胡锦涛、王岐山、王应祥、罗蓉等教授提供标本和资料方面的帮助;曾直接参与研究的华东师范大学生态研究室的教师和研究生(以先后为序)有陆厚基、张恩迪、徐宏发、胡江华、裴恩乐、林忠、杜卫国、赖军、李强、高志千、李明、黄步军、刘志霄、徐正强等;甘肃兴隆山高山自然保护区的王培民、张学炎、康发功、蒋应文等在麝的研究期间给予多方帮助,并提供资料及麝香分析样品,与上海市计量测试技术研究院的杨曙平和张敏研究员合作对这些样品进行了测试分析;刘学东和陈珉博士分别帮助对大别山麝等样品进行分子生物学分析;马逸清研究员在审阅绪论稿时,对“历史记载”部分作了重大补充、修改;编写过程中得到王小明、王天厚、徐宏发、唐思贤诸位教授的具体帮助,黄骥为本书绘图,郭光谱协助拍摄部分

林麝照片。

编写过程得到刘志霄博士的全面协助；邀请继承麝饲养研究的徐正强博士参与人工养殖的编写；邀请第二军医大学郑汉臣教授和他的学生黄宝康、陈磊、胡园编写麝香的药理及临床应用；与上海雷允上药业公司药品检测中心的叶愈青主任合作，完成真伪麝香的鉴别及含麝香的主要中成药内容；与上海科技馆黄骥合作研究麝的形态分类及麝的起源与演化。

本书一度曾因健康原因延缓了写作进度，经大家多年的努力，全部书稿终于能付梓出版了，谨此成书之际，向所有关心、支持和帮助过我们的所有单位和个人致以最诚挚的谢意！

最后，衷心感谢新老领导董智勇和孟宪林同志以及郑光美院士和张恩迪教授对该书出版所给予的热情支持和帮助；衷心感谢董智勇同志及马逸清研究员为本书写序；衷心感谢国际野生生物保护学会(WCS)、保护国际(CI)、国际爱护动物基金会(IFAW)和上海市野生动物保护协会资助本书出版；衷心感谢 C. P. Groves 教授校审英文稿、上海科学技术出版社的编辑同志对本书的精心设计和校对。

尽管本书凝聚了笔者最近二十年的实践和学术思想，但毕竟是在诸多同仁的参与下完成的，应当是全体人员的共同成果。限于笔者的水平和能力，书中仍有不少纰漏、错误及不当之处，敬请读者批评指正！当然，笔者最希望的是，这部著作的出版，能对中国麝的保护事业有所贡献！

笔者年事已高，别无他求，只盼中国麝资源的保护受到主管部门的无私关注，切实负责地保护好中国麝的资源宝藏。

盛和林

2006年12月1日

Foreword

Musk deer (*Moschus*) are among the most valuable of the game animals of China. The secretion from the preputial gland of males, known as musk, is an indispensable ingredient of much traditional Chinese medicine. Musk is familiar not only because of its remarkable medicinal effects, but it is also a favorite material for perfume manufacture. Over the long period of its use, musk has been credited with saving lives throughout history and among Chinese people is widely regarded as a key medicine. Its value has generally been rated as about equal to the same weight of gold, in the 70 – 80's of the last century it, actually reached several times this value, and this led to extensive overhunting and poaching of musk deer, and so to the catastrophic decline of the wild population in China. Musk deer are a shy and secretive mammal and little has hitherto been known about them.

The author's brief for his research is simply that, with limited time and energy remaining in his life, he should select the most valuable subject for research to fulfill his sense of self-worth. Over and above that, it was always in his mind to choose the most significant research objective he could find; and indeed it was already his wish as far back as the 1960s to explore the mystery of the Musk deer. Because existing conditions were not in favor of Musk deer research at that time, he had to content himself with other, more low-cost objectives. In 1981, when meeting by chance with Dong Zhiyong, the undersecretary of the forestry department, and Qing Jianhua, the undersecretary of conservation, the author was strongly encouraged and supported by them when he confided his long-held aspiration to study Musk deer and further their protection. They showed their interest and concern for the protection of wild animals, and they listened to this scholar's submissions sympathetically, in the same spirit which had made them so respected by the scholarly community. In the spring of 1982, the author realized his long-held dream to see the Musk deer research project officially established, and soon obtained financial support. Without their kind assistance, this book could never have been contemplated, and the author hereby would like to take this opportunity to show his great respect and gratitude to these two outstanding leaders.

Always with an eye on the twin topics of protection and utilization, this research was conducted with special attention to Musk deer conservation and focused in particular on Musk deer farming in different regions. Musk deer are farmed for different purposes: to obtain more musk and so mitigate the hunting pressure on wild populations, and to breed them and return the offspring back to the natural habitat. The restriction on the location of a farm is not food but high temperature in summer; the selected location for this research was therefore Zhou Shan Island in Zhejiang Province, where it is comparatively cool in summer. The sea served as a natural barrier and made it easy for Musk deer keeping. With the addition of high fencing, the farmed animals were transferred from Zhoushan first to Tianmu Mountain in Zhejiang, then to Shanghai's Chongming Island, and finally to Shanghai. The

results showed that Musk deer can not only survive, but also multiply and continue to secrete musk in those areas. The test has so far been successful. Although living in Shanghai is not the most ideal habitat for Musk deer, it has been demonstrated that they could at any rate be raised in captivity in different places. In the meantime, the preliminary "domestication" program of Musk deer is a success.

But, as the author has long insisted, central to musk deer conservation is the taking of effective measures on the wild population; the problem cannot be resolved just into one of establishing captive populations extensively over several decades. Conservation biology is always the focus of the author's study. The scientific results of the present volume derive from long-term investigations in Sichuan and Dabie mountains, and in particular on the Alpine Musk deer in Xinlong mountain, Shoulu mountain (Gansu province and Ningxia) and Helan mountain (Inner Mongolia). The author wishes to acknowledge his indebtedness to his colleagues and students as well as various forest departments for their kindness and help during his twenty years' investigations on musk deer.

Dr. Liu Zhixiao helped throughout the writing of the present volume; Dr. Xu Zhengqiang participated in the section on the captive breeding program; Prof. Zhen Hancheng and his students at the Second Military Medical University wrote the section on the pharmacology of musk. The author also collaborated with Mr. Ye Yuqing (Director of the Medical Identification Center of Shanghai Leiyunshang Medical Company) to prepare the section on musk identification and the chemical components of musk. J. Maza'k (mammalogist of the Shanghai Science & Technology Museum) was co-author of the section on the taxonomy and evolutionary history of the musk deer.

The completion of the present volume was delayed for a time due to the author's health problems, but with the support of many colleagues it has now progressed smoothly to final publication. The author wishes to extend his very sincere thanks to all who have kindly helped with his scientific research on musk deer.

Finally, the author would like to express his appreciation to Mr. Dong Zhiyong and Mr. Meng Xianlin, the former and present leaders of the China Forestry Department, respectively. Thanks also go to Academician Zhen Guangmei and Prof. Zhang Endi for their help with the publication of this monograph; to Mr. Dong Zhiyong and Prof. Ma Yiqing who wrote the preface; to Prof. C. P. Groves (Australian National University) for improving the English; to the Wildlife Conservation Society (WCS), Conservation International (CI), the International Fund for Animal Welfare (IFAW) and the Shanghai Society for Wildlife Conservation for their support of the publication of this monograph.

Although this volume presents the scientific understanding and the academic ideas of the author, and is the culmination of his research over the last twenty years, it can be regarded as the product in

common of all colleagues who have participated in author's musk deer project. Some mistakes have undoubtedly crept into this volume, and any queries dealing with its content are most welcome. The author hopes only that the present volume could be a contribution to the conservation program of the musk deer in China.

Sheng Helin

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