

CHINA

中国雉类

THE CHINESE PHASIANIDS

白腹锦鸡

LADY AMHERST'S PHEASANT

杨岚 等著

Yang Lan

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序

中国是盛产雉类的国家。世界雉科鸟类 183 种中，有 49 种分布于中国，其中 16 种已被列入世界濒危物种红皮书 (King, 1981)，占世界濒危雉类总数的 53%。

雉类资源丰富以及特产种众多这个特点，与中国得天独厚的自然条件以及雉类的生活习性有密切关系。中国幅员辽阔，地形和气候十分复杂，自然条件多种多样。大致以横断山脉及秦岭一线为界，将我国划分为具有不同特色的两大动物地理界，即以寒温带动物群为主的古北界和以热带、亚热带动物群为主的东洋界。一个国家拥有两种不同特色动物群的情况，在世界上仅有中国和墨西哥两个国家。从雉类的生活习性来说，它们绝大多数均为留鸟，终年在其栖息地内居留，仅有短距离的季节性移动，这与鹤类等许多鸟类所具有的季节性的、长距离迁徙的习性不同。作为鸟类中的一个类群来说，雉类的这种较普遍的留居习性，是比较突出的。人们自然就会得出这样的结论：对中国雉类，特别是特产雉类的资源保护和合理利用以及为此必须首先开展的生态学和生物学的深入研究工作，中国的鸟类学家是责无旁贷的。

白腹锦鸡的主要分布区在中国，见于西藏东南部、四川中部及西南部、贵州西部及云南大部；在国外仅分布于缅甸东北部的边界地区。有关在野外的生活习性以及生物学特性，以往了解得很少。由于它的羽色华丽，肉、蛋经济价值很高，早在上一世纪即被引出国外饲养繁殖。但是白腹锦鸡在饲养下与其它雉类，特别是红腹锦鸡杂交的现象十分普遍，所以目前国外

养殖的纯系白腹锦鸡已经很少 (Howman, 1979), 而且迄今也很少进行过饲养下的生物学研究。由此可见, 在白腹锦鸡的生态生物学研究方面, 尚为一个空白区。

由中国科学院昆明动物研究所杨岚副研究员等著述的《中国雉类——白腹锦鸡》一书, 是世界上首次对本种进行的系统、全面的科学研究的总结, 具有很高的学术水平。书中详尽地阐明了白腹锦鸡的研究历史、形态特征、系统分类地位、野外生态学以及涉及生长、换羽、营养成分、血相、染色体、同工酶、线粒体 DNA 等细胞学、生理生化学等方面的特征, 并全面介绍了人工养殖中的一些理论与实践问题。应该指出, 对野生鸟类的一个物种, 在相对较短的时间内, 能完成如此广泛、深入的研究, 也是为数不多的。这应归功于昆明动物研究所的领导和本课题主持者的远见, 他们能洞悉现代动物学的发展动向, 发挥本所多学科的优势, 使各方面的专家协同开展研究, 从而使对问题的认识和讨论深入了一步, 为国内同类研究树立了典范, 是值得学习的。

野生动物, 特别是雉类的研究有很大难度, 研究人员必须具有坚韧不拔的精神, 长期深入到人迹罕至的深山老林中, 经受着恶劣的自然条件的考验。尤其困难的在于时机难得, 一错过机会就得等待来年, 不像实验室研究有较多的可重复验证的机会。这就要求研究人员必须具有敏锐的观察力、严谨的科学态度和百折不回的意志。在当前野生动物研究方面人力严重不足、缺乏资金和助手的情况下, 更增加了难度。昆明动物研究所的同行们, 能够迎着困难上, 多年来不断发表新的研究成果, 受到国内外重视, 这种艰苦奋斗的精神是很值得敬佩和学习的。相信本书的出版将会进一步推动我国雉类的研究工作, 使雉类资源的保护、科学管理和利用提高到新的水平。

中国动物学会副理事长 郑光美
中国鸟类学会副理事长

1990年4月于北京

前 言

本书是基于中国科学院科学基金办 850561 生 85—641 号文批准资助的《白腹锦鸡生态生物学研究》和云南省应用基础研究基金资助的《白腹锦鸡的人工养殖研究》的研究结果撰写而成的。研究工作自 1986 年 1 月开始, 1989 年 12 月结束, 历时 4 年。

白腹锦鸡生态生物学及人工养殖的研究, 是涉及多学科的综合性的研究项目。参加研究工作的人员, 除我所鸟类学研究组的 7 位同志外, 还得到本所细胞遗传进化实验室和中心实验室同志的大力支持, 得到云南省畜牧兽医科学研究所禽病组协作。先后完成该课题各项研究内容的人员共计 26 人, 其中高级研究人员 3 人, 中级研究人员 5 人, 初级研究人员 18 人 (包括硕士研究生 2 人, 博士研究生 2 人)。通过 4 年时间的努力, 已经如期完成和超额完成了申报课题计划的研究内容, 达到了预期目标。该项研究成果, 由云南省科委和中国科学院昆明分院于 1990 年 5 月 28 日组织鉴定。在评审鉴定过程中, 北京师范大学生物系郑光美教授、中国科学院昆明动物研究所潘清华研究员、中国科学院动物研究所卢汰春副研究员、北京动物园高级畜牧师李福来等同行专家帮助审阅书稿, 并提出宝贵的修改意见, 谨此致谢。

编 者

1990 年 6 月

实验研究及编写分工

主持单位：中国科学院昆明动物研究所

- 杨 岚 主持课题。撰写绪论、名称与外部形态、地理分布、生境分布、野生资源的保护对策、分类地位及亲缘关系的探讨。统稿全书。
- 韩联宪 野外生态调查。撰写生态习性、笼舍设备及引种驯化。
- 王淑珍 饲养繁殖、营养与能量代谢、羽毛生长与脱换等实验。撰写繁殖。
- 杨晓君 饲养繁殖、营养与能量代谢、羽毛生长与脱换、生理指标的测定、疾病防治等实验。撰写饲料及饲养管理。
- 石文英 饲养繁殖、羽毛生长与脱换等实验。撰写羽毛生长与脱换顺序的观察。绘制全书插图。
- 陈 欣 同功酶的比较研究。
- 文贤继 骨骼系统的比较研究，幼鸟骨骼系统的生长。参加统稿工作。
- 陆 源 王达瑞 韩灯宝 机体营养成分的分析，营养及能量代谢。
- 张亚平 陈 欣 兰 宏 施立明 线粒体 DNA 的比较研究。
- 刘爱华 林世英 熊习昆 染色体组型和 G 带研究。
- 杨凤堂 施立明 减数分裂联会复合体组型分析。
- 郑宝贵 负责申请国家自然科学基金及课题设计。

协助单位：云南省畜牧兽医研究所

许文珍 许琳 王锐丽

江东汉 杨斌 姚艳

生理指标的测定、疾病防治。

Introduction

This book is a summary of the Project of Ecology, Biology and Artificial Breeding of Lady Amherst's Pheasant (*Chrysolophus amherstiae*) that was supported by National Natural Science Foundation of China and Yunnan Committee of Science and Technology. It is composed of three parts:

GENERAL DESCRIPTION

This part is a general description of Lady Amherst's Pheasant. It concisely stated the results of geographical distribution survey, ecological studies, evolutionary history and captive breeding of this pheasant. According to literature and the data collected from field surveys by the authors, a distribution map of the species was made (Fig. 1). Measurements of male adults, female adults and juvenile and a list of common names of this pheasant in its habitat of china were also given. The species mainly occupies southwestern China. The range from 23°1' to 30°3'N; 97° 14' to 106° 4'E. Habitats of Golden Pheasant (*Chrysolophus pictus*) and Lady Amherst's Pheasant overlap in the area about 23° 1' to 30°30'N; 102°8' to 106°4'E.

RESULTS OF STUDY

This part introduces the author's research work on Lady Amherst's Pheasant in detail.

1. Ecological study in the field

Initially this section present ecological field study results. Researchers in-

investigated the pheasant's habitat, breeding behavior, diet and feeding behavior, social behavior, calls, natural enemies and density of breeding birds in Gulu, where is located in west mountains of Kunming, Yunnan, from 1986—1987. The study showed that the Lady Amherst's Pheasant is a typical forest pheasant species. It mainly inhabits evergreen broadleaf—coniferous secondary forest, deciduous secondary forest and bush, and secondary forest of *Pinus armandii*. The breeding season of Lady Amherst's Pheasant is from March to July. During breeding season, Cocks take a certain territory and defend it firmly. It was always found that a cock wanders and feeds in forests with 2—4 hens in that period. In view of these observations, the species is thought to be polygamous. The size of nests and eggs is given in Tab. 2. The incubating period is 23 days. The incubation rhythm is given in fig. 3, Cocks neither take part in constructing the nest, nor incubating and raising the young. the diet of the Lady Amherst's Pheasant mainly consists of various plants and some invertebrates. The examination of food from the stomach showed that the plants are 91.7%; animals, 8.2%.

Lady Amherst's Pheasant crow call, contact call, alarm call, fear call, threat call and brood gather call were recorded, spectrographic analyses were made, and their biological meanings of these calls (Fig. 4—9) were discussed.

2. Biological study

Comparasion of Skeletal System of four pheasants: The author reported the results of comparative study of the skeletal system of Red Jungle Fowl (*Gallus gallus*), Ring-necked Pheasant (*Phasianus colchicus*), Golden Pheasant (*Chrysolophus pictus*) and Lady Amherst's Pheasant (*Chrysolophus amherstiae*); described intergeneric and interspecific skeletal differences of 3 genera and 4 species; presented the result of cluster analysis among 3 genera 4 species of 22 specimens based on 48 skeletal measurements, and discussed the intergeneric systematic relationships. The main results are as follows:

Gallus, *Phasianus* and *Chrysolophus* have some differences in their skeletal systems: the postorbital process and zygomatic process are fused together in *Gallus* and *Phasianus*, but they are separated in *Chrysolophus* (Fig. 12). The carnia sizes of *Gallus* and *Phasianus* are almost the same, and bigger than that of *Chrysolophus* (Fig. 13, Table 8). The tarsometatarsuses of *Gallus* and *Chrysolophus* are longer than that of *Phasianus* (Table 8).

The skeletal forms of Golden Pheasant are very similar to those of Lady

Amherst's Pheasant, but the ulna length of Lady Amherst's Pheasant is slightly longer than that of Golden Pheasant (Table 8) .

In the process of cluster analysis *Gallus* gathers first with *Phasianus* when Euclidean distance is 13.0012, then they gather with *Chrysolophus* when Euclidean distance is 15.3379 (Table 9, Fig. 21).

According to the results of cluster analysis and the skeletal difference in form, the author considered *Gallus* and *Phasianus* have closer relationship, *Chrysolophus* is probably a relatively specialized and isolated genera in Phasianini.

Postnatal Growth of the Skeletal System in Captivity: With the method developed by Dingerkus and Uhler (1977) the author made 30 skeletal specimens of the Lady Amherst's Pheasant (*Chrysolophus amherstiae*) chicks at different ages. In this chapter the author described the skeletal postnatal growth and fusion from 1 to 143 day old; reported some bone growth equations from 1 to 41 day old; and discussed significance of the growth modes to chick survival. Fig. 22—28 show the process of ossification and fusion of the bones of skull, mandible, sternum, pelvic girdle, pygostyle, carpus bones and metacarpals, tibia and metatarsals with tarsals from 1 to 143 day old. From 1 to 41 day old, the growth modes of all bones which were measured are $Y=a+bx$ (Fig. 19, Table 11—12), while the growth equations of body weight are: ♂♂: $Y=3.1267+0.0096x^2$; ♀♀: $Y=4.0692+0.0109x^2$. The sequence of development and growth is: in the period of hatching the brain and feeding structure (premaxilla, maxilla and mandible ect.) develop most completely in all bones which were measured, the lower limb develops more completely than upper limb; in the 41 day postnatal growth, the growth rate of upper limb is the fastest in all bones which were measured, but the growth rate of body weight is not constant, the older the chicks are, the faster the body weights grow.

Growth and moults of plumage: This section recorded the sequence of growth and moult of the remiges and rectrices of young Lady Amherst's Pheasant in captivity (Tab. 15; Fig. 32—39).

Test of physiological index: 23 healthy individuals of Lady Amherst's Pheasant were tested. The following are given: the total number and classification of white blood cell, the total amount of haemoglobin and total number of red blood cell, the analytical results of albumin and seroglobulin, the body temperature and the frequency of breath (Tab. 16—19).

Analyses of nutrition of tissues and organs: The contents of water, ash, fat, protein and carbohydrate in some tissues and organs of Lady Amherst's Pheasant were measured. (Tab. 20). The percentage of 17 amino acids and the content of ordinary trace elements in some tissues and organs were also tested (Tab. 21—22).

The chromosomes of Lady Amherst's Pheasant: The diploid chromosome number of Lady Amherst's Pheasant is 82. The sex chromosome pair is ZZ in the male, and ZW in the female. No. 1 and Z were submetacentric, Nos. 3—4 and W were subtelocentric, and the others were telocentric. The G—band of macrochromosomes were also studied.

Analysis of synaptonemal complexes in spermatocytes of Lady Amherst's Pheasant: 41 SCs with heavy stained Rinetochoces were found in the spermatocytes of the species at meiotic prophase using the surface spread and silver—staining method. Based on the relative lengths and centromere index, the SC karyotype was constructed. The results showed a striking constancy of relative length between the SCs and somatic Chromosomes.

Comparative studies on the isozymes: Comparative studies on the isozymes among Golden Pheasant, Lady Amherst's Pheasant and Ring—necked Pheasant were conducted by using the techniques of vertical polyacrylamide gel electrophoresis.

The ETS pattern of Golden Pheasant is 5 bands, the Lady Amherst's Pheasant is 8 bands. Both of them have 5 bands of same mobility. Both female and male of Ring—necked Pheasant have 11 bands, the relative mobility is shown in Fig. 26.

The statistical result indicate that the genetic similiarity of golden Pheasant with Lady Amherst's Pheasant is 62%, with Ring—necked Pheasant is 23%. The genetic similiarity of Lady Amherst's Pheasant and Ring—necked Pheasant is 35%.

The analysis of AMY map shows that the map of the Golden Pheasant and Lady Amherst's Pheasant is the same. Both of them are 5 bands. The map of ACP is similar to that of AMY. There is only one band difference in Golden Pheasant and Lady Amherst's Pheasant, we come conclusion that the biochemical of Golden Pheasant and Lady Amherst's Pheasant is very similar. there is a remarkable difference in *Phasianus* and *Chrysolophus*.

Comparative study of mitochondrial DNA (mtDNA) : The genetic distance

(The number of nucleotide substitutions per site) among three species of pheasants, i.e., Ring-necked Pheasant, Golden Pheasant and Lady Amherst's Pheasant was estimated, and the results were summarized in Tab. 28. Golden Pheasant and Lady Amherst's Pheasant are two closely related species, and Ring-necked Pheasant is distantly related to these two species. A molecular phlogenetic tree of the three species was constructed. It was suggested that the genetic distance (P) between genus *Phasianus* and *Chrysolophus* was 0.076. This datum was in the rang of P between some species of the same genus in birds (ranging from 0.004 to 0.090), and therefore demonstrated that these two genera were closely related. The P between Lady Amherst's Pheasant and Golden Pheasant was 0.012, and lower than P between most species in birds. The result suggested that the species were very related on molecular level. Divergence times was estimated on supposing the mean rate of sequence divergence of 0.02 per million years in mtDNA (Shield, et al., 1987). Divergence in the genus *Chrysolophus* might be started 0.6 million years (Myr) ago and about 3.6 million years ago between *Chrysolophus* and *Phasianus*.

ARTIFICIAL BREEDING

This section narrates the preparatory work in early breeding season, such as dispose nest in captivity, arrangment of male and female in each breeding flock, feeding and daily management in breeding season, and minute observation and description of the courtship behavior, egg laying of Lady Amherst's Pheasant. It compares the characteristics, advantages and disadvantages of incubation with domestic hen, and incubator. Also discusses the different proportion of foods, the effect of feeding, the management of immature. Last it introduces the infection experiment and checks for disease of easy infections of Lady Amherst's Pheasant. And then some methods for disease—control are given.

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一、绪 论

(一) 白腹锦鸡的历史记载 与鉴别

我国古代对锦鸡属鸟类的记载，以明代（公元 1596 年）出版的《本草纲目》禽部第四十八卷鹭（音敝 bi）雉一条最为经典。“鹭雉又称山鸡、锦鸡《禽经》、金鸡《纲目》、采鸡、骏奴《周书》”。集解中记述：“山鸡出南越诸山中，湖南、湖北亦有之。状如小鸡，其冠亦小，背有黄赤文，绿项红腹……。逸周书谓之采鸡，锦鸡则小于鹭，而背文扬赤，膺前五色炫耀如孔雀羽。此乃尔雅所谓‘鷩（音汗 han）天鸡’者也。逸周书谓之文鷩。二种大抵同类，而锦鸡文尤灿烂如锦。……”从这段记载，说明我们的祖先对锦鸡属两个种的形态特征、地理分布有了一定的认识。

锦鸡属鸟类在全世界的分布，截至目前为止，仅记录有白腹锦鸡和红腹锦鸡两个种（郑作新等，1978, Howard, R. *et al*, 1980）。据 Schauensee (1984) 记载，在 17 世纪初，或更早些时候，一些中国特产的鸟类就开始输入欧洲。红腹锦鸡在 1735 年以前就输入了欧洲，林奈在 1785 年出版的《自然系统》一书中，描记了红腹锦鸡（又名金鸡），命名为 *Phasianus pictus*；继后 Leadbeater 根据采自云南（郑作新，1976, 1987）的白腹锦鸡标本，描记了白腹锦鸡，发表于 1829 年的伦敦林奈学会会报，命名为 *Phasianus amherstiae*。这两份原始文献，均将该两种归列于雉属。1834 年，