

# 长江、珠江、黑龙江 鲢、鳙、草鱼种质资源研究

李思发 吴力钊 王强 仇潜如 陈永乐 等著

上海科学技术出版社

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# COMPREHENSIVE GENETIC STUDY ON CHINESE CARPS

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## 内 容 简 介

这是一本对长江、珠江、黑龙江鲢、鳙、草鱼种质资源具有开创性研究的专著。全书从形态判别、年龄生长、发育遗传、生化遗传、染色体组型、养殖性能、种质资源保护等方面进行阐述。书中列举了大量的具有科学性和可靠性的数据，对发展淡水养鱼业和鱼类种质资源的开发利用及遗传保护具有重要意义。

本书可供国内外水产养殖、鱼类学、生物学、遗传育种学、动物地理学等学科领域中的科技人员和大专院校的师生参考。

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# 前 言

我国是世界最大淡水渔业国。鲢、鳙、草鱼是我国产重要经济鱼类,是我国淡水渔业、特别是淡水养殖业的柱石。

在我国,鲢、鳙、草鱼的养殖虽已有 1360 多年的历史,但对这些鱼类的生物学研究却只是二十世纪以来才开始的,并已取得丰硕的成果,尤其是繁殖生物学的研究,叩开了人工繁殖的大门。然而,还有许多领域研究得尚不充分,有的甚至还是空白,其中,鲢、鳙、草鱼遗传性状就是一直缺少系统研究的一个重要方面,致使良种选育工作缺少科学依据,对于人工繁殖群体的经济性状衰退现象无法作出正确的解释和采取有效的防止措施。

为了改变上述状况,1982 年,原农牧渔业部下达给上海水产大学“家鱼考种研究”课题,从 1983 年起,又列入了国家科技攻关项目“淡水鱼类育种技术及繁育体系”的研究,经过有关专家的论证后,“家鱼考种研究”成为该攻关项目的子课题——“长江、珠江、黑龙江鲢、鳙、草鱼原种收集与考种”,由上海水产大学、中国科学院水生生物研究所、中国水产科学研究院长江水产研究所、黑龙江水产研究所及珠江水产研究所等五单位协作进行。

七年来,课题组同志奔走各大河流,进行实地考察研究和科学试验。经过通力合作,运用数量遗传、生化遗传及渔业生物学原理和计算机判别、电泳分析等新技术,对长江、珠江、黑龙江三个水系的鲢、鳙、草鱼从形态特征、年龄生长、生化遗传及养殖性能等方面进行了比较全面和系统的研究,主要有以下几个方面:

1. 查明了长江、珠江、黑龙江三水系鲢、鳙、草鱼种群间及长江、珠江两水系鳙鱼种群间在形态特征上的差异,建立了计算机判别

程序。

2. 比较研究了长江、珠江、黑龙江鲢、鳙、草鱼种群在自然条件下的生长特点和年龄组结构。

3. 研究了长江、珠江、黑龙江鲢、鳙、草鱼种群的生化遗传结构与差异,以及长江鲢、鳙、草鱼发育遗传等。

4. 研究了长江、珠江水系鲢、鳙鱼的生长性能与繁殖性能。

5. 调查了长江、珠江、黑龙江鲢、鳙、草鱼的资源现状,三水系三种鱼的资源均处于不同程度的衰退中。

6. 先后收集和试验了三水系三种鱼的原种的鱼苗、成鱼约 50 万尾。向上海、广东、湖北等地鱼种场提供长江水系原种约 500 尾,均已投入人工繁殖生产。

7. 提出了鲢、鳙、草鱼种质资源保护措施和原种种质标准参数。

围绕以上诸方面,五个协作单位的研究人员已经先后在国内、外一级学术刊物上发表了论文报告 11 篇,待发表的有 4 篇。本书进一步汇总和整理了这些研究成果。

值此书付梓之际,我们谨向支持、鼓励和关心这一工作的领导单位和领导同志表示衷心的感谢。这一研究工作的完成和此书的出版,若对我国今后鱼类种质资源、遗传育种及水产增养殖研究,以及我国淡水渔业生产能起些促进作用,都是他们大力领导和热情支持的结果。没有国家科委、经委、农业部水产司的支持,这一工作是难以完成的。

上海水产大学还要特别感谢国际科学基金会 (International Foundation for Science) 的支持。早在 1981 年,当李思发在加拿大访问研究期间形成了比较研究鲢、鳙、草鱼不同种群的种质的初步构思和设计时,就得到了国际科学基金会的理解和支持。几年来,得到国际科学基金会资助美金 4 万元,此外,国际科学基金会还两次资助李思发参加国际学术会议,这对促进这一项目的开展也起了积极作用。



我们还要感谢许多曾参加或帮助过这一研究工作的同志,如白俊杰、孙建民、刘青华、刘寒文、李庆国、李奕群、李国华、李丽坤、林康生、张敏、钟海浪、贾长春、栾晓红、梁幼嫦、黄丽英、曹永长、曹渠江等(按姓名笔划排列)。

最后,我们向有关高等院校、科研机构、行政管理部门及生产单位的专家们对书稿的审阅表示深切的谢意。还要感谢加拿大淡水研究所(Freshwater Institute) G.B.Ayles 博士修饰前言和各部分提要的英文稿。

全书最后由李思发统一定稿。内容既考虑到全书的系统性与完整性,也反映各协作单位的工作情况。

**著者** 1989年8月

## PREFACE

China is the largest producer of freshwater fish in the world. The major endemic freshwater fish, particularly for aquaculture are silver carp, bighead and grass carp.

Although the culture of silver Carp, bighead and grass carp in China dates back over 1300 years, extensive scientific studies only began during the 20th Century.

Although some significant results have been achieved, for example, the results of reproductive biology opened the doors to artificial reproduction, many fields have been inadequately studied. In particular, genetic performance of the carp family has largely been ignored prior to the studies presented here.

In 1982, a research project entitled "A Genetic Study of Chinese Carp Populations" was assigned to Shanghai Fisheries University by the Ministry of Agriculture (formerly Ministry of Agriculture, Livestock and Fisheries).

Studies on selection techniques and breeding systems of freshwater fishes have been identified "Genetic Studies of Chinese Carp Populations", later renamed "Collection and Genetic Studies of Silver Carp, Bighead and Grass Carp Populations in the Changjiang River, Zhujiang River and Heilongjiang River" has been specifically identified as a sub-topic for state research.

The research projects on carps have been jointly conducted by the Shanghai Fisheries University, Changjiang River Fisheries Research Institute, Zhujiang River Fisheries Research Institute and the Heilongjiang River Fisheries Research Institute of the Chinese Academy of Fisheries Sciences, Hydrobiology Institute of the Chinese Academy of Sciences respectively.

The joint efforts and detailed investigations of scientists throughout China resulted in a successful completion of the project. The major studies are as follows:

1. Significant morphological differences were found among silver carp and grass carp populations from the Changjiang, Zhujiang and Heilongjiang Rivers and between bighead populations from the Changjiang and Zhujiang Rivers (There is no natural population of bighead in Heilongjiang River). A computerized discriminant analysis was used for the statistical analysis.
2. Cooperative studies have been completed on growth performance and age structure of silver carp, bighead and grass carp under the natural conditions in the Changjiang, Zhujiang and Heilongjiang Rivers.
3. Biochemical genetic studies have been completed for silver carp, bighead and grass carp populations of the Changjiang, Zhujiang and Heilongjiang Rivers and

developmental genetics studies of the same three species have been completed for Changjiang River populations.

4. Studies of performances of growth and maturity have been completed for silver carp and bighead of the Changjiang and Zhujiang Rivers.
5. The present status of native populations of all three species in the three river systems has been investigated.
6. Large numbers of fry and adults of all three species have been collected from the three river systems. Approximately 500 original fish brood stock have been supplied to various production units.
7. The criteria parameters of silver carp, bighead and grass carp of origin are proposed for brooder stock management and selection. Proposals of genetic conservation are presented.

Scientists from five different institutes working on these studies have published 11 reports in national and international journals and four more papers are currently in press. The present book covers the technical findings of those studies and other unpublished work.

On the occasion of the publication of this book, the authors would like to express their heartfelt thanks to all the authorities and various institutions for their strong support, encouragement and concern. We hope this book will further contribute to the future studies on the genetic resources, genetic and breeding engineering, enhancement and aquaculture as well as the development of freshwater fisheries in China. The achievements are also due to the assistance, from the State Scientific and Technical Committee, State Economic Committee and the Aquatic Product Bureau of the Ministry of Agriculture.

The Shanghai Fisheries University and Professor Li Sifa are specially grateful to the International Foundation for Science (IFS) for the financial support to the research project "A Comparative Study on the Strains and Selective Breeding of Chinese Farm Fish". The proposal was initially supported in 1981 when Li Sifa was on a study visit to Canada. Since that time, IFS has contributed a total of \$40,000 US dollars. The majority of the funds were used to purchase equipment essentially needed for the research projects. In addition, IFS has supported attendance at two international academic conferences, thus greatly accelerating the progress and implementation of the research project.

We also wish to thank all our colleagues who participated or helped in their research project. Their names are listed below.

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The book is edited by Li Sifa.

**The authors,**

**August, 1989**

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## 概 论

鲢 *Hypophthalmichthys molitrix* (Cuvier et Valenciennes)、鳙 *Aristichthys nobilis* (Richardson) 及草鱼 *Ctenopharyngodon idellus* (Cuvier et Valenciennes) 是只产生于中国、越南北部及苏联远东地区的世界性重要经济鱼类。这三种鱼和青鱼 *Mylopharyngodon piceus* (Richardson) 一起〔在中国南部, 则代之以鲮 *Cirrhinus molitorella* (Cuvier et Valenciennes)〕, 在我国被称之为“家鱼”。在国际上, 这三种鱼则被统称为中国鲤鱼——Chinese carps。这些鱼的适温范围较广, 植物食性较强, 养殖经济价值很高。

按照 Расс 与 Линдберг(1971)的分类法, 鲢、鳙、及草鱼的分类地位如下:

Vertebrata 脊椎动物门

Craniata 有头动物亚门

Osteichthyes 硬骨鱼纲

Actinopterygii 辐鳍亚纲

Cyprionomorpha 鲤形总目

Cypriniformes 鲤形目

Cyprinoidei 鲤亚目

Cyprinidae 鲤科

Hypophthalmichthyinae 鲢亚科

Leuciscinae 雅罗鱼亚科

在鱼类分类学上, 鲢、鳙、草鱼各只有 1 个种。它们自然分布于东亚的大、中型江河水系中。鲢鱼北起黑龙江 (尼可里斯基, 1956; 任慕莲, 1981; 李思忠, 1981), 中经黄河(李思忠, 1981 及个人通讯)、淮河(邹鹏, 1954; 中国科学院南京地理研究所, 1981)、长江(中国科学院水生生物研究所, 1976; 李思忠, 1981)、钱塘江(陆桂等, 1960)\*、闽江(朱元鼎等, 1984)、珠江(钟麟等, 1965), 南至红河(元江)(陈公三, 1963; 潘仲厚等, 1966), 都有其分布(见图 1)。但鳙鱼的自然分布区较鲢鱼为窄, 北至黄河, 南至珠江; 而草鱼是北至黑龙江, 南至珠江。这些鱼类都起源于中国平原复合体, 但由于长期的地理隔离, 形成了不同的地理种群。例如, 黑龙江水系的鲢、草鱼, 就是在新世以前, 当嫩江与辽河、渤海相通的时候, 由江河平原区进入黑龙江水系的。鳙鱼可能是由于耐寒力较差, 未能在该处自然生存\*\*。而珠江水系的鲢、鳙、草鱼则可能是当冰川期海平面较现在低 100 多米时, 由长江、钱塘江下游扩展过去的, 鲢鱼又进而扩展到海南岛的南渡江和越南的红河的。

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\* 陆桂等, 1960。钱塘江鱼类。铅印本。

\*\* 李思忠、方芳, 1989。鲢、鳙、青、草四大家鱼地理分布的研究。手稿。