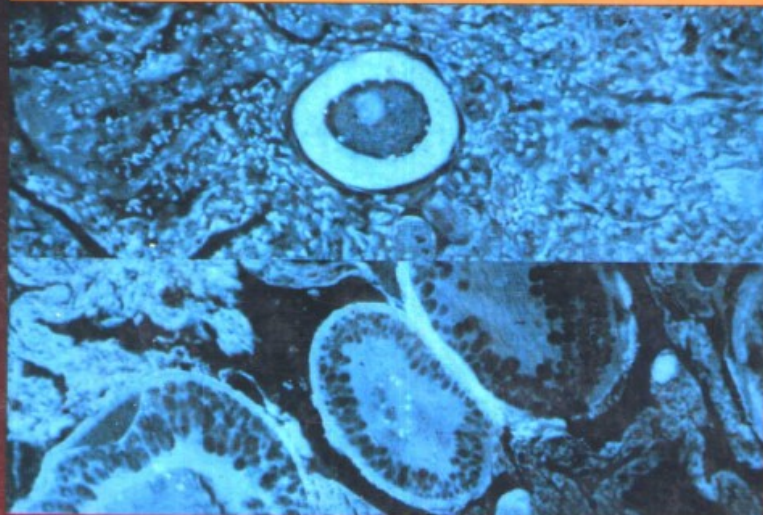
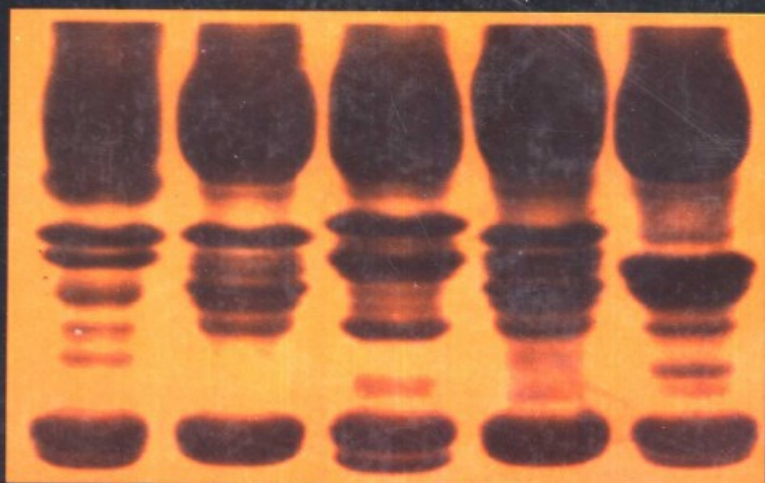


● 中国农业科学专著集

# 鱼类 遗传育种工程

FISH GENETICS AND BREEDING ENGINEERING

吴清江 桂建芳 等著



上海科学技术出版社

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吴清江 桂建芳 等著

上海科学技术出版社

•The Monographs on Agricultural Science of China

# Fish Genetics and Breeding Engineering

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by

Wu Chingjiang, Gui jinfang et al.

Shanghai Scientific & Technical Publishers

## 内 容 简 介

本书以中国科学院水生生物研究所鱼类遗传育种研究室在鱼类遗传育种方面所取得的一系列开创性研究成果为主线,配合国内外在这一领域的研究概况,从鱼类遗传育种工程的发育生物学基础和遗传学基础到新高生物技术的应用和育种实践作了系统的论述,对水产养殖业的持续发展和鱼类资源的合理利用具有重要意义和实用价值。本书是迄今世界上比较完善的阐明鱼类遗传育种工程的知行合一的专著,可供国内外从事鱼类遗传学、发育生物学、育种学、水产养殖以及相关生命科学和生物工程学等学科领域的科技人员和大专院校的师生参考。

## 鱼 类 遗 传 育 种 工 程

吴清江 桂建芳 等著

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# 序 言

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与 2 000 多年悠久的养鱼历史相比,我国较大规模开展鱼类遗传育种研究的历史仅有 20 多年。研究历史短,而且起步远远落后于发达国家,但传统产业与现代生命科学相结合,特别是与 80 年代以后发展的新高生物技术的结合使鱼类遗传育种的研究领域很快出现生机。短短 20 多年来,我国不但在遗传育种理论上而且在技术上都取得了重大突破。异精雌核发育生物学效应的发现对天然雌核发育的传统概念作了重要的补充和修正,并由此培育出了异育银鲫,带动了鲫鱼养殖业的发展;三倍体和四倍体鱼类的性细胞发生和生殖方式改变的研究结果对于异源多倍体的育种实践和阐明天然雌核发育鱼类的起源提供了理论依据;鱼类的人工单性发育、性别控制和遗传标记的研究成果为纯系的快速构建和选种奠定了技术基础;而体细胞克隆鱼的产生和转基因鱼模型的建立即是国际上的首创成果。上述理论和技术上的成就不仅建立了细胞工程和基因工程等育种生物技术,而且多种技术综合应用形成了配套的工程技术路线。应用这一综合配套的技术路线,通过研究,不断向社会推出了许多具有重要经济价值的养殖新对象,形成了我国鱼类遗传育种工程的特色。

本书作为专著,力求科学的严密性,写作上试图总结和提供

一些有关鱼类选种与育种的基础知识和实践经验。本书部分内容取自国际上最典型的成果和经验,并且引述了大量的文献,可供有兴趣的读者进一步阅读,但大部分内容是中国科学院水生生物研究所鱼类遗传育种研究室近30年来综合利用新高生物技术并与传统选育手段相结合产生的研究成果。编写出版本书的目的是在系统总结已取得的成就的基础上,进一步开拓其理论与实践,力争起到抛砖引玉的作用,以推动这一领域的进步和快速发展。全书分为三篇二十一章,第一篇第一章至第四章是概述与鱼类遗传育种有关的基础理论;第二篇第五章至第十四章是鱼类遗传育种工程的有关技术方法;第三篇第十五章至第二十一章是本研究室近年来的研究成果。

根据1996年国家统计资料,我国的水产总产量为2 813万吨,其中养殖产量为1 371万吨,占总产量的54.4%。随着总产量的进一步提高,养殖产量的比重将进一步加大。然而,水产养殖业所面临的主要问题之一是培育能在水体中高密度饲养、能够迅速生长和具有抗病能力的新品种。虽然我国“四大家鱼”的养殖历史已逾千年,但由于其繁殖周期较长,选育相对困难等原因,到现在为止我们养殖的仍是野生或最多是半野生的种群,根本还没有真正的养殖品种。无论是农业“八字宪法”或水产的“八字宪法”,“种”都被摆到很重要的位置,说明产量的提高在很大程度上依赖于良种。因此,鱼类遗传育种工作仍任重而道远,愿本书的出版能促进鱼类遗传育种工程的进一步开展。

参加本书撰稿的还有:崔宗斌(第十章)、陈宏溪(第十二章)、汪亚平(第十三章)、梁绍昌(第十五章)、朱蓝菲(第十六章)、叶玉珍(第十七章和第二十章)、俞小牧、陈敏容和杨兴祺(第二十一章)。感谢他们的艰辛劳动,是他们促成了本书的完成

和出版。

在撰写过程中,我们力求内容科学性,理论与实践结合,但限于水平,错漏和立论不当之处可能不少,恳请读者勿吝示教。

吴清江 桂建芳

1998年10月



## Introduction

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China the earliest country having aquaculture practice in the world. In spite of her aquaculture recorded more than 2 000 years, China has a history of study on fish genetics and breeding less than 30 years. However, the traditional breeding method combining with modern life sciences, especially with new and high biotechnology developed in the latest two decades, the bright aspect of developing in the field of fish genetics and breeding appears quickly, even its history of research is shorter and stepped far behind developed countries. In the past of two decades, new breakthrough has been made not only in the theories but also in the technology for fish genetics and breeding. The discovery of biological effects on allogynogenesis revised and enlarged the traditional concept of natural gynogenesis, therefore, an allogynogenetic silver crucian carp was bred. At the same time, the cultivation industry of crucian carp was advanced. The results of studies on ontogeny of gametocytes and variation of reproduction mode in triploid and tetraploid fishes offered theoretical basis for practice of allopolyploid fish breeding and interpretation for origin of natural gynogenetical fishes. The achievements in artificial gynogenesis, sex control and genetic marker researches built technology basis for rapid establishment of pure line and selection. Again, the production of somatic cell nucleus cloned fish and the establishment of transgenic fish model is the first reports in the world. The achievements in theories and technologies mentioned above not only constituted cytoengineering and gene-engineering biotechnolo-

gy for fish breeding, but also the well-matched engineering route was formed due to integrated application of multiple disciplines. By means of this matched engineering route several new economically important fish culture objects were bred and popularized continuously. Combining breeding investigation with popularizing new culture objects is the peculiarity of fish genetic and breeding engineering in China.

As a scientific book the present work was devised to be scientific severity, while readers will find some knowledge of both basic theory and practice about fish selection and breeding. Parts of contents of present book were pulled out from model achievements and experiences in the world, as well as abundant references for further reading was presented. However, the major part of contents is research fruits of our Department of Fish Genetics and Breeding, Institute of Hydrobiology, the Chinese Academy of Sciences. These research fruits were obtained by means of combination of new high biotechnology with traditional selection. The main purpose of this book is to summarize achievements obtained by us and we will be satisfied if reader gains enough insight into theories and practices of fish genetics and breeding from it. We hope that this book should serve as a baseline from which researchers in fish genetics and breeding launch further investigation and obtain bright achievements. The organization of the present book was designed to contain 3 sections. The first section contains chapters 1~4 dealing with basic theories about fish genetics and breeding, the second section being chapters 5~14 describing biotechnology methods concerning fish genetics and breeding, then the third section containing chapters 15~21 introducing research fruits of our Department in the past years.

According to the governmental statistic datum in 1996, the total yield of fisheries in China was 28130 thousand tons. Among them, the yield of cultural production was 15310 thousand tons, 54.4% of the total yield. In pace with continuous rise in total yield of fisheries in future years, the proportion of the cultural production will be further enlarged.

Therefore, one of the main problems faced by aquaculture industry will be breeding of new strains that can grow fast and possess capacity of resisting pathogens in intensive culture water bodies. Although, the cultivation history of so-called "Four Important Domestic Fish" was over thousand years in China, however, as a result of their long reproduction cycle and difficulty in selection, there has been no real cultivation strain in China as well as in the world. The broodstock of so-called "Four Domestic Fish" are all wild or semi-wild species now. The strains of seeds were put in an important position not only in "Eight Character Constitution" of agriculture, but also in "Eight Character Constitution" of aquaculture, because a better harvest depended on the good strain of seeds to a great extent. Therefore, there is a difficulty and long journey in the researches of fish genetics and breeding. We are in great hope that the publishing of this book will promote the fish genetics and breeding researches to a new stage.

We especially wish to thank a number of co-authors who have made their valuable contribution to this book: Cui Zongbin (Chapter 10), Chen Hongxi (Chapter 12), Wang Yaping (Chapter 13), Liang Shaochang (Chapter 15), Zhu Lanfei (Chapter 16), Ye Yuzhen (Chapter 17, Chapter 20), Yu Xiaomu, Chen Minrong and Yang Xinggi (Chapter 21). We thank these co-authors for their hard work; they assisted and conducted the completion and publication of present book.

In present book we have tried our best to provide the readers a scientifically strict and understandable, theoretical and practical book. However, there would be some errors in description, and differences of opinion concerning the interpretation. The authors will be grateful if the readers could point out mistakes in present book so that next edition these mistakes will be taken care of.

**Wu Chingjiang and Gui Jianfang**

October 1998

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