World Perch and Bass Culture:
Innovation and Industrialization

世界鳜鲈养殖创新与产业化

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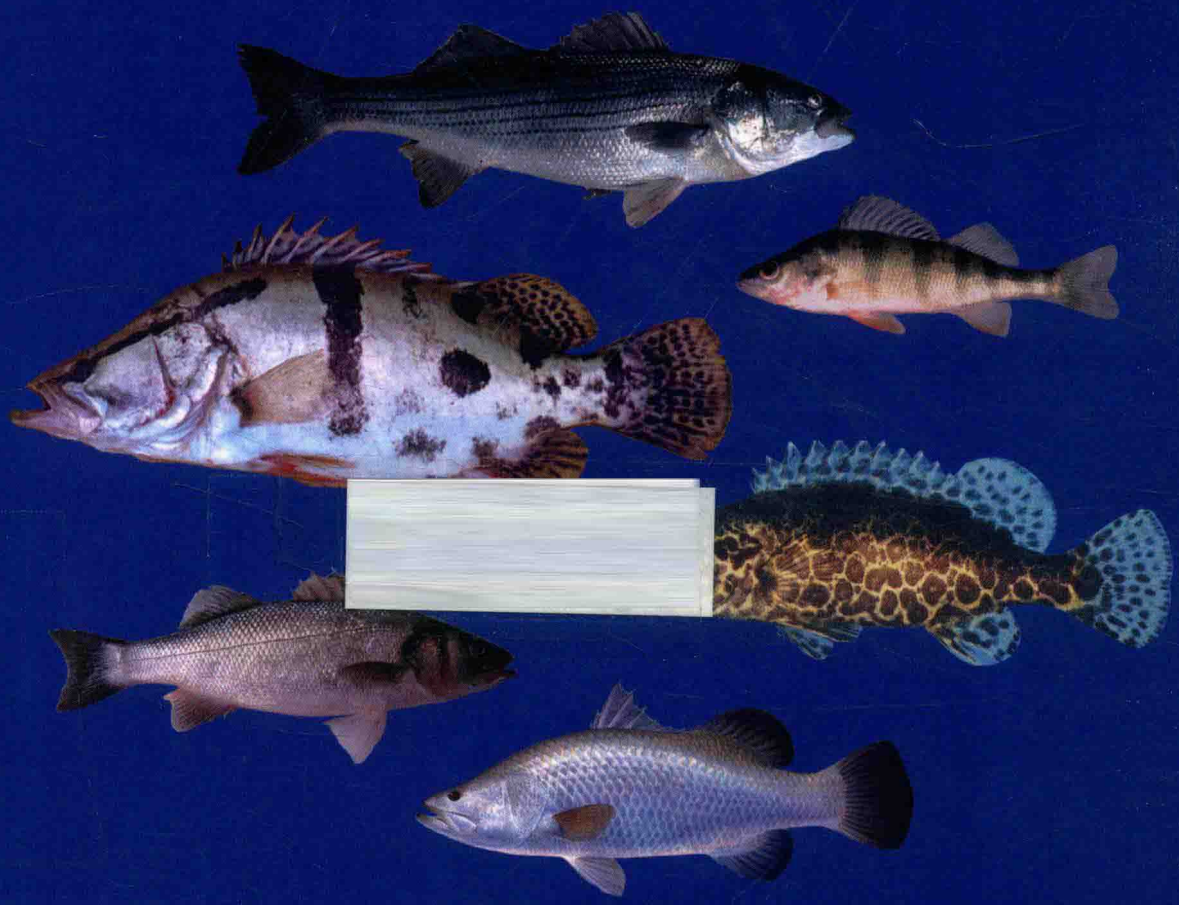

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华中农业大学鳜鱼研究中心

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内 容 简 介

本书从全球视野的角度，全面系统地展现了世界鳜鲈产业现状、科技创新进展及产业化前景。全书共分 10 章，分别介绍了中国鳜鱼营养与摄食的早期研究、中国鳜鱼遗传育种和饲料养殖研究、中国大口黑鲈和花鲈营养和饲料研究进展、美国黄金鲈遗传选育、美国养殖鲈类营养学、美国杂交条鲈养殖现状与展望、美国条鲈属温水鲈类养殖与基因组育种研究进展、欧洲狼鲈养殖与育种现状、欧洲赤鲈与梭鲈养殖现状、澳大利亚鲈类育种与养殖现状等。

本书可供中外从事水产养殖专业科技工作的有关学者和专业技术人员参考使用。

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前　言

鳜鲈是主要栖息于温带淡水及咸淡水的世界性名贵食用鱼类，隶属鲈亚目的鮨科（温水鲈科或鳜科）、鲈科、狼鲈科（条鲈科）、尖吻鲈科等。2015 年全球鳜鲈产量约 100 万吨，其中中国产量约 70 万吨。目前，中国主要养殖温水性的鳜鱼、大口黑鲈、花鲈，少量养殖暖水性的尖吻鲈、宝石鲈、鳄鲈及亚冷水性的梭鲈。美国主要养殖温水性的条鲈、大口黑鲈及亚冷水性的黄金鲈、大眼梭鲈。欧洲主要养殖温水性的狼鲈及亚冷水性的赤鲈、梭鲈。澳大利亚主要养殖暖水性的尖吻鲈，少量养殖温水性的金鲈、银鲈及暖水性的宝石鲈、鳄鲈。

鳜鲈经济价值之大堪比冷水性的鲑鳟鱼类，由于鳜鲈普遍比鲑鳟生长更快且适于养殖区域范围更广，与全球已十分成熟的鲑鳟养殖产业相比，全球鳜鲈养殖产业发展空间还非常大，目前的鳜鲈产业尚处于早期发展与快速崛起阶段。

世界鲑鳟养殖学术交流在推动全球鲑鳟产业发展过程中发挥了重要作用，特别是美国、欧洲各国及日本等鲑鳟专家密切的合作创新直接促成了快速发展壮大的挪威和智利三文鱼（大西洋鲑）养殖大产业。2016 年挪威和智利三文鱼（大西洋鲑）产量合计约 250 万吨，已发展成为全球第一的世界水产养殖大产业。

与世界鲑鳟养殖研究领域密切的学术交流相比，全球视野的鳜鲈养殖合作交流还十分滞后，特别是中国与美国、欧洲各国及澳大利亚等发达国家在该领域交流合作还非常缺乏。中国鳜鲈养殖产量虽已雄踞全球第一，但相关研究成果多以中文发表，目前养殖产品也基本未进入国际市场。

1976 年 9 月 24 日至 10 月 5 日，国际鲈科鱼类学术研讨会在加拿大安大略省召开，会议论文集 1977 年以专辑在《加拿大渔业研究委员会会刊》（*Journal of the Fisheries Research Board of Canada*）发表。但该次会议及出版的会议论文集仅关注北美洲、欧洲及中亚黄金鲈、赤鲈、梭鲈、北美梭鲈等鲈科鱼类（欧美淡水鲈类）资源保护利用问题，未涉及其集约化可控养殖产业发展问题。此后，英国学者 John Craig 教授 1987 年出版的《赤鲈及相关鱼类生物学》（*Biology of Perch and Related Fish*）与 2000 年再版的《鲈科鱼类：系统分类学、生态学和利用》（*Percid Fishes*: *Systematics*, *Ecology and Exploitation*）也均未涉及鲈科鱼类养殖产业发展问题。直到 2015 年，由美国和英国学者 Patrick Kestemont 教授、Konrad Dabrowski 教授、Robert Summerfelt 教授共同主编出版专著《鲈科鱼类的生物学和养殖》（*Biology and Culture of Percid Fishes*），对北美和欧洲鲈科鱼类（欧美淡水鲈类）主要种类的养殖问题进行了系统总结。

欧美澳咸淡水鲈类研究专著近期也不断出版。2014 年澳大利亚学者 Dean R. Jerry 教授主编出版专著《尖吻鲈的生物学和养殖》（*Biology and Culture of Asian Seabass Lates calcarifer*），2015 年西班牙学者 Javier Sánchez Vázquez 和 José Muñoz-Cueto 共同主编出

版专著《狼鲈的生物学》（*Biology of European Sea Bass*）。

但时至今日，仍然缺乏具有全球视野、包含中国在内的世界鳜鲈养殖学术交流与相关专著出版。1986 年 5 月美国爱达荷大学 Ronald W. Hardy 教授应邀专程来中国湖北省武汉市主持鳜鱼摄食和营养研究工作 6 周，期望攻克鳜鱼拒食人工饲料技术难关，开创了中美鳜鲈养殖研究合作交流的先河。Hardy 教授自此以后还多次来中国并一直致力于促进中国鳜鲈及现代水产养殖产业的发展。作为此书副主编的 Ronald W. Hardy 教授，现担任国际水产刊物《水产养殖研究》（*Aquaculture Research*）主编和美国国家水产营养饲料委员会主席。

2013 年 9 月以中美鳜鲈产业创新论坛为主体内容，我们在中国湖北省武汉市华中农业大学组织召开了首届国际鳜鲈学术研讨会。2016 年 10 月在王宽诚教育基金会与大北农神爽水产科技集团共同资助下，我们在华中农业大学组织召开了第二届国际鳜鲈学术研讨会暨首届全国鳜鲈产业创新论坛。第二届国际鳜鲈学术研讨会有来自中国、美国、西班牙、比利时、英国、新加坡、澳大利亚等各国学者，围绕鳜鱼、大口黑鲈、黄金鲈、赤鲈、梭鲈、条鲈、狼鲈、尖吻鲈等主要品种的遗传育种、营养饲料及可控养殖方面科技创新与产业问题进行了深入交流。

本书是基于这两届国际鳜鲈学术研讨会的固化成果，由现代农业产业技术体系专项资金(CARS-46)资助。我们期望本书能从全球视野的角度，给读者系统展现世界鳜鲈产业现状、科技创新进展及产业化前景。为方便中国鳜鲈企业读者阅读，本书以中英文对照出版。华中农业大学刘红教授在会议组织召开和会议材料准备，特别是对本书编辑和中文翻译做了大量烦琐而重要的工作。俄亥俄州立大学 Joy Bauman 女士和 Sarah Strausbaugh 女士也对本书英文编辑和会议材料的准备做出贡献。由于时间匆忙，加上编著者水平有限，书中难免有纰漏之出，恳请广大读者批评指正。

梁旭方（华中农业大学）
Han-Ping Wang（俄亥俄州立大学）
2017 年 3 月

Preface

Perch and bass, belonging to Serranidae (Percichthyidae or Sinipercidae), Percidae, Moronidae, and Latidae families of the Perciformes, are mainly distributed in temperate or sub-cold fresh water or brackish water. These species have worldwide importance as food and recreational fish. Global production of perch and bass is around 1,000,000 ton, with 70% produced in China, mainly including temperate species such as Chinese perch (*Siniperca chuatsi*), largemouth bass (*Micropterus salmoides*), and Japanese sea bass (*Lateolabrax japonicus*). Some warm water species such as Asian sea bass (*Lates calcarifer*), jade perch (*Scortum barcoo*), and murray cod (*Maccullochella peelii*), as well as some sub-cold water species, such as pikeperch (*Sander lucioperca*), are produced in smaller amounts. In the United States, the main perch and bass aquaculture fish include the temperate striped bass (*Morone saxatilis*) and largemouth bass species, as well as the sub-cold water species, yellow perch (*Perca flavescens*) and walleye (*Stizostedion vitreum*). In Europe, European sea bass, European perch (*Perca fluviatilis*), and pikeperch are major perch and bass aquaculture species. While in Australia, the dominating related aquaculture species is Asian sea bass, and there is some production of silver perch (*Bidyanus bidyanus*), golden perch (*Macquaria ambigua*), jade perch, and murray cod.

The economic value of perch and bass is comparable to cold water species salmon and trout. Comparing to the globally mature aquaculture industry of salmon and trout production, perch and bass are generally suitable for a wide-range of rearing areas and are well-suited for commercial production because of their fast growth. Aquacultural production of perch and bass is in the early stages of development and expanding rapidly. Therefore, there is much potential for expansion of perch and bass aquaculture.

International collaborations in salmon and trout aquaculture play an important role in the rapid development of the global industry of its kind. Especially, close collaborations among experts and scientists from North America, Europe, and Asia have driven innovations and promoted the rapid expansion of the Atlantic salmon aquaculture industry.

In perch and bass aquaculture, global collaboration is still in an infant stage when compared to salmon and trout. Particularly, collaboration between China and developed countries, e.g., U.S.A, Europe, and Australia, is insufficient. In addition, most of the research results and information in China are published in Chinese and aquaculture platform has not outreached international market yet, even though perch and bass production in China ranks No.1 globally.

The first International Symposium of Percids was held in Ontario, Canada from September 24 to October 5, 1976. Conference proceedings were then published in the *Journal of the Fisheries Research Board of Canada* as a special issue in 1977. The focus of this symposium and the proceedings were on natural resource conservation and utilization of some percid species such as yellow perch, European perch, and pikeperch in North America,

Europe, and Central Asia, while the industry development of intensive aquaculture of these species was not included. Later on, two related books, *Biology of Perch and Related Fish* by Dr. John Craig in 1987 and the 2nd edition, *Percid Fishes*: *Systematics*, *Ecology and Exploitation* in 2000 did not cover aquaculture development of percid fishes either. Until recently, the book *Biology and Culture of Percid Fishes* edited by Dr. Patrick Kestemont, Dr. Konrad Dabrowski, and Dr. Robert Summerfelt have systematically summarized aquaculture issues of major culture percid species in North American and Europe.

There are a few books on bass species published in recent years, e.g., *Biology and Culture of Asian Seabass Lates calcarifer* by Australian scholar Dr. Dean R. Jerry in 2014, *Biology of European Seabass* by Spanish scholars Dr. Javier Sánchez Vázquez and Dr. José Muñoz-Cueto in 2015.

Globally, the inclusion of Chinese scholars in the scientific exchange and international platform development on perch and bass aquaculture has only been initiated lately. In May 1986, Dr. Ronald Hardy was invited to Wuhan to guide feeding and nutritional research work for six weeks, in order to solve a weaning issue of Chinese perch, initiating collaboration between China and the United States of America in perch and bass aquaculture. Since then, Dr. Hardy had visited China several times to promote development of the perch and bass aquaculture industry.

In September 2013, focusing on the industry development of perch and bass in China and the United States, we hosted and organized the first International Symposium of Perch and Bass at the Huazhong Agricultural University, Wuhan, China. In October 2016, we organized the 2nd International Symposium of Perch and Bass at Huazhong Agricultural University. The conference was sponsored by the K. C. Wong Education Foundation and DBN Fantastic Aquaculture Science & Technology Group. Scholars from China, the United States, Spain, Belgium, United Kingdom, Singapore, and Australia presented their recent developments and innovations in genetics and breeding, nutrition, and culture technologies in major aquaculture perch and bass species, such as Chinese perch, largemouth bass, yellow perch, European perch, pikeperch, striped bass, European sea bass and Asian sea bass.

This book "World Perch and Bass Culture: Innovation and Industrialization" is based on these two symposiums. This book is supported by China Agriculture Research System (CARS-46). We expect to provide readers a global view of aquaculture technology development and innovations, and promote industrialization in perch and bass. For the convenience of Chinese readers, this book is written in both English and Chinese. We thank Dr. Hong Liu at Huazhong Agricultural University for her efforts in conference organization, material preparations, chapter translations and editing, and Joy Bauman and Sarah Strausbaugh at the Ohio State University for their English editing and material preparations.

Xu-Fang Liang (Huazhong Agricultural University)
Han-Ping Wang (The Ohio State University)
March, 2017

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