

World Perch and Bass Culture:
Innovation and Industrialization

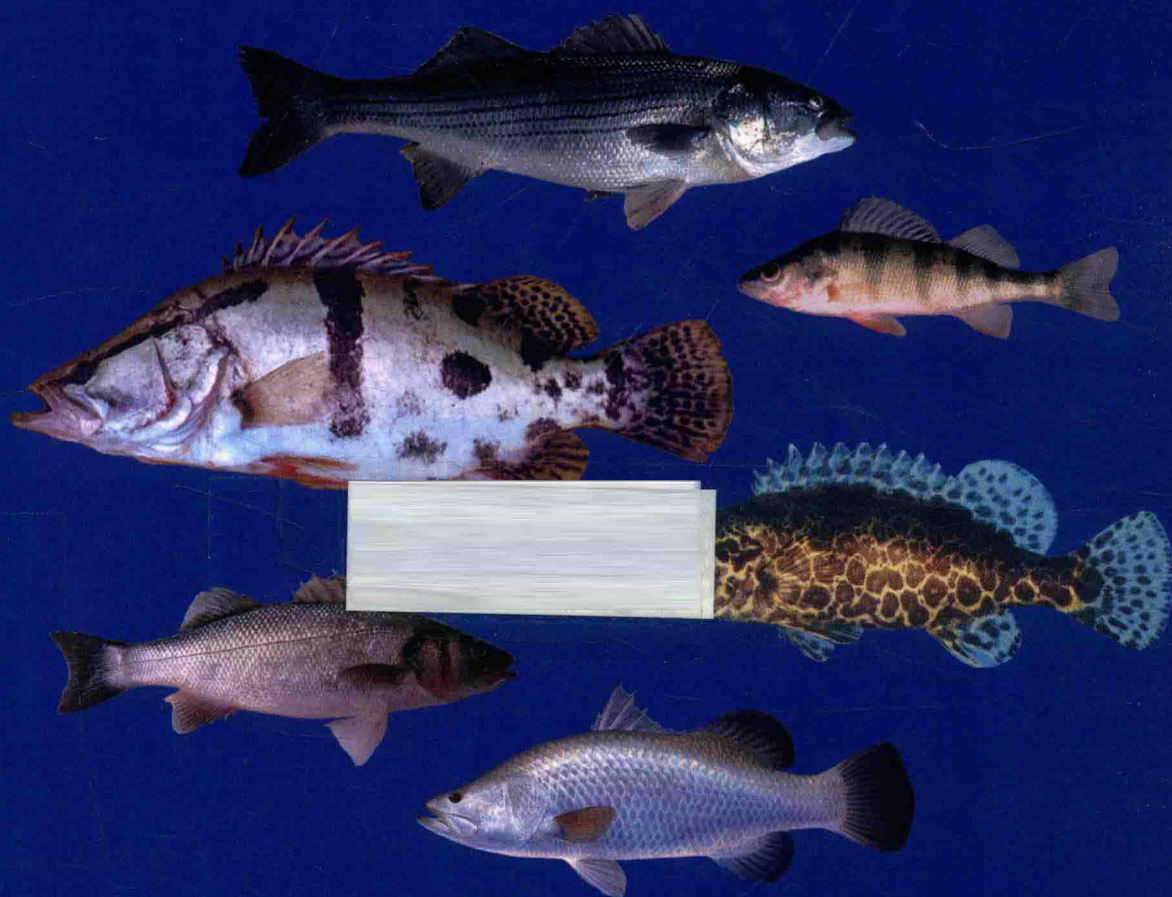
世界鳜鲈养殖 创新与产业化

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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鳊鲈产业现状、科技创新进展及产业化前景。全书共分10章,分别介绍了中国鳊鱼营养与摄食的早期研究、中国鳊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，隶属鲈亚目的鲈科（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、鳙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、鳙鲈。

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鳊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鳊鱼摄食和营养研究工作6周,期望攻克鳊鱼拒食人工饲料技术难关,开创了中美鳊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鳊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月以中美鳊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鳊鲈学术研讨会。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鳊鲈学术研讨会暨首届全国鳊鲈产业创新论坛。第二届国际鳊鲈学术研讨会来自中国、美国、西班牙、比利时、英国、新加坡、澳大利亚等各国学者,围绕鳊鱼、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鳊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鳊鲈产业现状、科技创新进展及产业化前景。为方便中国鳊鲈企业读者阅读,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。

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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.

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March, 2017

目 录

第一章 中国鳊鱼营养与摄食早期研究	1
一、引言	1
二、前期研究	2
三、在未开口鱼苗上的试验	3
四、使用 10~15mm 鱼苗的试验	4
五、摄食行为试验	5
六、结论	7
第二章 中国鳊鱼遗传育种和饲料养殖研究	8
第一节 鳊鱼产业与国内外研究现状分析	8
一、鳊鱼食性与养殖产业问题	8
二、鳊鱼驯食研究现状	9
三、鳊鱼种业发展现状	10
第二节 鳊鱼种群遗传学研究	11
一、基于磁珠富集法和转录组文库的鳊鱼微卫星标记开发	11
二、翘嘴鳊主产区野生与养殖群体的遗传多样性及遗传结构差异分析	13
第三节 翘嘴鳊华康 1 号选育系遗传结构分析	21
一、翘嘴鳊连续 5 代选育群体遗传多样性及遗传结构分析	21
二、翘嘴鳊华康 1 号遗传组成分析：长江中游翘嘴鳊与大眼鳊杂交渐渗现象研究	29
三、翘嘴鳊华康 1 号选育系遗传结构分析	35
四、华康 1 号新品种	39
第四节 鳊鱼饲料养殖研究	50
一、鳊鱼摄食感觉原理研究	50
二、鳊鱼饲料利用性状的遗传基础研究	52
三、鳊鱼饲料养殖	63
第三章 中国大口黑鲈和花鲈营养和饲料研究进展	81
第一节 大口黑鲈营养型肝病研究进展	81
第二节 花鲈动植物蛋白源替代鱼粉创新研究进展	84
一、混合动物蛋白直接替代或补充氨基酸后替代鱼粉对花鲈生长及体成分的影响	85
二、蛋白质水平和混合动物蛋白替代鱼粉对花鲈生长性能和体成分的影响	88

三、鱼粉质量及混合动物蛋白替代鱼粉对花鲈生长性能及肉品质的影响	95
四、发酵豆粕替代鱼粉对花鲈生长、肉质及氮磷排泄的影响	103
五、混合植物蛋白替代鱼粉对花鲈 GH/IGF-I 轴及肉品质的影响	113
六、混合植物蛋白完全替代鱼粉对花鲈短期生长、摄食、GH/IGF-I 轴及 Ghrelin/Leptin-NPY/AGRP 和 mTOR-NPY 摄食调控信号通路的影响	123
第四章 美国黄金鲈遗传选育	139
第一节 黄金鲈微卫星标记的开发与亲子鉴定技术的建立	139
一、黄金鲈微卫星标记的开发	139
二、黄金鲈亲子鉴定技术的建立	145
第二节 黄金鲈群体遗传学分析	151
一、黄金鲈群体采集	151
二、群体遗传学分析	152
三、结语	156
第三节 黄金鲈生长性状微卫星标记辅助育种技术	156
一、家系构建、育苗与驯食	158
二、育种技术一	158
三、育种技术二	158
四、不同池塘养殖环境评估	160
五、不同池塘中黄金鲈群体遗传结构	160
六、黄金鲈亲子鉴定	161
七、黄金鲈生长性状和家系大小的池塘效应	161
八、黄金鲈不同年龄阶段体重遗传相关和表型相关	163
九、不同育种技术黄金鲈生长性状比较	163
十、不同育种技术的比较	164
十一、结语	165
第四节 黄金鲈生长性状基因环境互作分析	166
一、混养条件下黄金鲈家系的生长性能及基因环境互作分析	166
二、黄金鲈体重遗传力和基因环境互作分析	168
第五节 生长性状与个体杂合度和微卫星等位基因距离相关性分析	172
一、材料鱼来源	173
二、基因分型与分析	173
三、黄金鲈生长性状	174
四、黄金鲈生长性状与个体杂合度相关性	174
五、黄金鲈生长性状与个体微卫星等位基因距离相关性	176
六、结语	177
第六节 黄金鲈生长性状遗传力和遗传相关分析	177
一、家系混养和采样	178

二、亲子鉴定、遗传力和遗传相关评估	179
三、池塘养殖黄金鲈生长性状遗传力和遗传相关	179
四、水缸养殖黄金鲈生长性状遗传力和遗传相关	180
五、结语	180
第七节 标记辅助黄金鲈生长性状选育六代遗传多样性分析	181
一、选育策略和选育世代的建立	181
二、取样和微卫星基因分型	182
三、数据分析	182
四、遗传多样性分析	182
五、结论	183
第五章 美国养殖鲈类（条鲈、大口黑鲈、黄金鲈、赤鲈）营养学：新兴水产 养殖品种的营养需求和操作	188
一、引言	188
二、鲈（bass）饲料的早期试验	189
三、鲈（perch）饲料的早期试验	190
四、营养素需求	192
五、应用中的挑战	192
六、组学研究	194
七、实际应用	195
八、结论	196
第六章 美国杂交条鲈养殖现状与展望	197
一、条鲈属	197
二、形态特征	197
三、研究概述	197
四、杂交条鲈养殖的发展和商业化	198
五、产量统计	198
六、生物学和养殖方法	199
七、行业扩展的限制和前景	204
八、遗传改良	206
九、结论	210
第七章 美国条鲈属（温水鲈类：狼鲈科）养殖与基因组育种研究进展	211
一、条鲈	211
二、美国杂交条鲈	211
三、白条鲈	212
四、水产养殖研究和育种	212
五、遗传改良和驯养	213

六、基因组资源 214

七、机器学习法 216

八、结论 217

第八章 欧洲狼鲈养殖与育种现状 218

一、引言 218

二、生物学特性 219

三、养殖 220

四、生殖生理学 220

五、繁殖 223

六、基因组资源 225

七、选择育种 225

八、结论 226

第九章 欧洲赤鲈与梭鲈养殖现状 228

一、简介 228

二、欧洲鲈科鱼的养殖 229

三、使用室内 RAS 系统养殖的生产和性能指标 230

四、赤鲈和梭鲈的繁殖 232

五、未来挑战 236

第十章 澳大利亚尖吻鲈、银鲈、宝石鲈、金鲈及鳙鲈育种与养殖现状 238

一、尖吻鲈 (*Lates calcarifer*: Latidae) 238

二、银鲈 (*Bidyanus bidyanus*: Terapontidae) 241

三、宝石鲈 (*Scortum barcoo*: Terapontidae) 244

四、金鲈 (*Macquaria ambigua*: Percichthyidae) 246

五、鳙鲈 (*Maccullochella peelii*: Percichthyidae) 248

Chapter 1 Early Research on Nutrition and Feeding of Chinese Perch
(*Siniperca chuatsi* Basilewsky, 1855) in China 252

1. Introduction 252

2. Initial research 253

3. Experiments with unfed fry 254

4. Experiments with 10-15mm fry 255

5. Experiments with feeding behavior 256

6. Conclusions 259

References 259

Chapter 2 Breeding and Feeding of Chinese Perch 260

1. Analysis of natural resources and genetic diversity in Chinese perch 260

2. Genetic basis of feeding habit domestication trait in Chinese perch.....	260
3. Molecular markers of growth trait and feeding habit domestication trait for Chinese perch	261
4. The hybrid <i>Siniperca</i> strains display hybrid advantages on traits for both growth and feeding habit domestication	261
5. Sensory basis of Chinese perch refusing artificial diets.....	261
6. Specific training procedure to wean Chinese perch from live prey fish to artificial diets.....	262
7. Nutritional requirements of Chinese perch	262
Chapter 3 Status of Nutritional and Feed Research in Largemouth Bass and Japanese Sea Bass in China	264
1. Research progress of nutritional liver disease in largemouth bass.....	264
2. Effects of fish meal replacement by animal protein blend with or without essential amino acids supplementation on growth and body composition in Japanese sea bass	264
3. Effects of fish meal replacement by animal protein blend at two digestible protein levels on growth and body composition in Japanese sea bass under ideal digestible amino acid profile	265
4. Effects of fish meal replacement by animal protein blend and fish meal quality on growth and flesh quality in Japanese sea bass	265
5. Effects of fish meal replacement by fermented soybean meal on growth, flesh quality and nitrogen and phosphorus metabolism in Japanese sea bass.....	266
6. Effects of replacement of fish meal by plant protein blend on growth performance, GH/IGF-I axis and flesh quality in Japanese sea bass	266
7. Effects of total fishmeal replacement by plant protein blend on short-term feeding, growth performance, GH/IGF-I axis and Ghrelin/Leptin-NPY/AGRP, mTOR-NPY signal pathway in Japanese sea bass	267
Chapter 4 Selective Breeding of Yellow Perch	268
1. Introduction.....	268
2. Genetic tool development	268
3. Selection strategy and establishment of base and selected generations	268
4. Selection response and growth performance tests	269
5. Genetic variability of selected populations	269
6. Conclusion	270
Chapter 5 Bass and Perch Nutrition: Requirements and Experimental Approaches for Emerging Aquaculture Species.....	271
1. Introduction.....	271
2. Initial considerations-bass.....	272
3. Initial considerations-perch.....	274
4. Nutritional requirements	276

5. Practical challenge	277
6. The -omics era	279
7. Practical application	279
8. Conclusions	280
Acknowledgements	281
References	281
Chapter 6 Status and Prospective for North American Hybrid Striped Bass Production	284
1. The genus <i>Morone</i>	284
2. Meristic characteristics	284
3. Historical overview	285
4. Development and commercialization of <i>Morone</i> hybrids	286
5. Production statistics	287
6. Biology and culture methods	290
7. Constraints and prospects for expansion	296
8. Genetic improvement	299
9. Conclusion	305
Acknowledgements	305
References	305
Chapter 7 Genomic Enablement of Temperate Bass Aquaculture (Family Moronidae)	313
1. About striped bass	313
2. About hybrid striped bass	315
3. About white perch	316
4. Aquaculture research and breeding	316
5. Genetic improvement and domestication	317
6. Genomic resources	321
7. A machine learning approach	323
8. Closing remarks	324
Acknowledgements	325
References	325
Chapter 8 State of Culture and Breeding of European Sea Bass, <i>Dicentrarchus labrax</i> L.	332
1. Introduction	332
2. Biological features	333
3. Culture	335
4. Reproductive physiology	336
5. Breeding	340
6. Genomic resources	343
7. Selective breeding	344

8. Conclusions.....	345
Acknowledgments	345
References.....	346
Chapter 9 State of Percid Fish Aquaculture in Europe	352
1. Introduction.....	352
2. Percid fish aquaculture in Europe	353
3. Production and performance indicators for the grow-out using an indoor RAS.....	355
4. Reproduction of percid fish	357
5. Future challenges	362
References.....	365
Chapter 10 Australian Farmed Perches	367
1. Barramundi (<i>Lates calcarifer</i> : Latidae)	367
2. Silver perch (<i>Bidyanus bidyanus</i> : Terapontidae)	373
3. Jade perch/barcoo grunter (<i>scortum barcoo</i> : Terapontidae).....	378
4. Golden perch (<i>Macquaria ambigua</i> : Percichthyidae).....	381
5. Murray cod, (<i>Maccullochella peelii</i> : Percichthyidae).....	384
References.....	387