

# *Aquaculture I*

## *FAS 4932 (3 credits) Fall, 2020*

### **Course Description**

Provides an overview of the field of aquaculture, including water quality, production systems, nutrition, spawning, and the common fish and invertebrate groups cultured in the United States. The course is entirely web-based, with narrated PowerPoint lectures followed by readings and other resources for each learning topic. Weekly topics are included in asynchronous class discussions.

### **Instructors**

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### **Student Learning Outcomes**

At the end of this course, each student will:

- Have an understanding of the basic principles of aquaculture
- Have an understanding of culture methods for common aquaculture species
- More effectively communicate through scientific writing
- Have a foundation for graduate studies in aquaculture or a career in aquaculture

### **Course Meeting Times**

This course is entirely web-based and students may access lectures, readings, and supporting materials at their own pace. Exams are available only on the dates listed in the syllabus.

## Required Texts/Readings

There is no required text for the course. Online readings will be provided for each learning topic (list attached). A computer with internet connection and sound speakers are required. The UF Canvas E-Learning site can be accessed at <http://elearning.ufl.edu/> using your Gatorlink account.

## Class Format, Policies on Attendance and Make-up Exams

The class is in an asynchronous, web-based format. There are no pre-requisites for taking this course. Attendance records will not be maintained. **It is the responsibility of the student to access on-line lectures, readings, quizzes, discussions, and exams and to maintain satisfactory progress in the course.** Two exams are scheduled (see schedule below) and are only available on the days scheduled. **Missed exams cannot be taken after the scheduled date without prior written consent of the instructor except under exceptional circumstances.** Cases of serious illness, bereavement, or activities covered under the Twelve-Day Rule will be considered for make-up. Appropriate documentation must be provided in all cases. Computer or other hardware failures, except failure of the UF E-Learning system, will not excuse students for missing exams. For computer, software compatibility, or access problems call the HELP DESK phone number—352-392-HELP = 352-392-4357 (option 2). A writing or presentation assignment is due. Late assignments will be penalized 10% for the first day and 5% per day thereafter unless prior written arrangements are made or there is an exceptional circumstance.

### Assignments

- *Learning modules consisting of one or more lectures (narrated PowerPoint or video), readings, supporting material, discussion, and a quiz are provided online for each topic. Learning modules build on previous modules so you should complete the learning modules in the order presented.*
- *Learning modules covered on the mid-term exam (modules 1-9) are available from the beginning of the semester. Learning modules covered on the final exam (modules 10-20) are available after the mid-term exam. You may access and complete learning modules at your own pace.*
- *Each learning module will have a narrated PowerPoint presentation/video. Each presentation will have numerous photographs or diagrams and will summarize important information for each topic. You will be able to go back and view and listen to each slide as many times as you wish during the initial viewing of the lecture or at a later date.*
- *Each learning module has required readings beyond the lecture. This information will be covered on quizzes and exams. These files will all be made available for you to view on your computer, save, or print. There will also be references to additional (optional) readings if you desire further investigation of a topic.*
- *Most learning modules will have a discussion related to the topic of the module. Students are required to participate in at least 5 discussions in the first half of the*

semester (Modules 1-9) and at least 5 in the second half (Modules 10-21).

Participation can include posting answers or additional, pertinent questions. A robust discussion rather than a few simple answers will make this a more useful enterprise. In particular, students posing questions/thoughts discussed by other students in the class will provide an excellent learning environment. Instructors and a TA will assist in moderating to ensure a fact-based discussion.

- Each learning module will have a quiz. The questions will require the student to go through the PowerPoint presentation, watch any attached videos, and read the assigned readings to answer the questions correctly. These quizzes will contribute to the grade. Quizzes in Modules 1-9 are taken prior to the Mid-term and quizzes in Modules 10-21 are taken prior to the final exam. All quizzes will be taken from your computer.
- Mid-term and final exams: Each exam will consist of 50 questions. Some of the questions will come directly from the lecture quizzes. These exams will consist of multiple choice questions and maybe a few matching questions. The mid-term will consist of questions from the first half of the learning modules. The final exam will consist of questions from the last half of the learning modules. The exams will be taken on your computer. Exams are only available on the days indicated.
- Graduate students and others registered in FAS 5015 have to complete either a review paper or Voicethread presentation on a pre-approved aquaculture topic. Undergraduates and others registered in FAS 4932 do not have this assignment.

## Evaluation of Student Learning

45% or 205 points	Quizzes
11% or 50 points	Discussion participation
22% or 100 points	Mid-term exam (Learning modules 1-9)
22% or 100 points	Final exam (Learning modules 10-21)

455 points total

## Grading Scale

Grade	Percentage	Points
A	90-100	≥ 410
B+	85-89.99	387-409
B	80-84.99	364-386
C+	75-79.99	341-363
C	70-74.99	318-340
D+	65-69.99	296-317
D	60-64.99	273-295
E	< 60	≤ 272

## Schedule of Class Topics

### Learning Modules

1. Introduction to Aquaculture
2. Fish Biology
3. Water Quality Management
4. Recirculating Aquaculture Systems
5. Farm Ponds
6. Net Pens
7. Nutrition and Feed Manufacture
8. Handling and Hauling
9. Spawning
10. Disease
11. Prawns/Shrimp
12. Catfish
13. Hybrid Striped Bass
14. Tilapia
15. Salmonids
16. Freshwater Ornamentals I
17. Freshwater Ornamentals II
18. Marine Ornamentals
19. Marine Baitfish
20. Clams, Oysters, Scallops
21. Other Important Species

### Important Dates:

*August 31 – Classes start*

*August 31-October 18 – Modules 1-9 available (Quizzes and Discussions)*

*October 18-23 – Mid-term exam available*

*October 19-December 9 – Modules 10-21 available (Quizzes and Discussions)*

*December 9 – Classes end*

*December 10-11 – Reading days*

*December 12-18 – Final exam available*

## Other Information

### **Academic Honesty, Software Use, UF Counseling Services, Services for Students with Disabilities**

In 1995 the UF student body enacted an [honor code](#) and voluntarily committed itself to the highest standards of honesty and integrity. When students enroll at the university, they commit themselves to the standard drafted and enacted by students.

In adopting this honor code, the students of the University of Florida recognize that academic honesty and integrity are fundamental values of the university community. Students who enroll at the university commit to holding themselves and their peers to the high standard of honor required by the honor code. Any individual who becomes aware of a violation of the honor code is bound by honor to take corrective action. The quality of a University of Florida education is dependent upon community acceptance and enforcement of the honor code.

**The Honor Pledge: We, the members of the University of Florida community, pledge to hold ourselves and our peers to the highest standards of honesty and integrity.**

On all work submitted for credit by students at the university, the following pledge is either required or implied: "**On my honor, I have neither given nor received unauthorized aid in doing this assignment.**"

The university requires all members of its community to be honest in all endeavors. A fundamental principle is that the whole process of learning and pursuit of knowledge is diminished by cheating, plagiarism and other acts of academic dishonesty. In addition, every dishonest act in the academic environment affects other students adversely, from the skewing of the grading curve to giving unfair advantage for honors or for professional or graduate school admission. Therefore, the university will take severe action against dishonest students. Similarly, measures will be taken against faculty, staff and administrators who practice dishonest or demeaning behavior.

Students should report any condition that facilitates dishonesty to the instructor, department chair, college dean or Student Honor Court.

It is assumed all work will be completed independently unless the assignment is defined as a group project, in writing by the instructor.

This policy will be vigorously upheld at all times in this course.

### **Software Use:**

All faculty, staff and students of the university are required and expected to obey the laws and legal agreements governing software use. Failure to do so can lead to monetary damages and/or criminal penalties for the individual violator. Because such violations are also against university policies and rules, disciplinary action will be taken as appropriate.

### **Campus Helping Resources**

Students experiencing crises or personal problems that interfere with their general well-being are encouraged to utilize the university's counseling resources. The Counseling & Wellness Center provides confidential counseling services at no cost for currently enrolled students. Resources are available on campus for students having personal problems or lacking clear career or academic goals, which interfere with their academic performance.

- *University Counseling & Wellness Center, 3190 Radio Road, 352-392-1575, [www.counseling.ufl.edu/cwc/](http://www.counseling.ufl.edu/cwc/)*

Counseling Services

Groups and Workshops

Outreach and Consultation

Self-Help Library

Training Programs

## Community Provider Database

- *Career Resource Center*, First Floor JWRU, 392-1601, [www.crc.ufl.edu/](http://www.crc.ufl.edu/)

### **Students with Disabilities**

The Disability Resource Center coordinates the needed accommodations of students with disabilities. This includes registering disabilities, recommending academic accommodations within the classroom, accessing special adaptive computer equipment, providing interpretation services and mediating faculty-student disability related issues.

0001 Reid Hall, 352-392-8565, [www.dso.ufl.edu/drc/](http://www.dso.ufl.edu/drc/)

### **Readings for Aquaculture I**

#### Introduction to Aquaculture

USDA. 2013. Aquaculture. U.S. Department of Agriculture National Agricultural Statistics Service.

USDA. 2013. 2012 Census of agriculture. U.S. Department of Agriculture National Agricultural Statistics Service.

USDA. 2013. Census of aquaculture. U.S. Department of Agriculture National Agricultural Statistics Service.

FAO. 2014. The state of world fisheries and aquaculture. Food and Agriculture Organization of the United Nations.

FAO. 2015. FAO Global Aquaculture Production database updated to 2013—summary information. Food and Agriculture Organization of the United Nations.

#### Introduction to Fish Biology

FWC. 2016. Fish anatomy. Florida Fish and Wildlife Conservation Commission.

<http://myfwc.com/fishing/freshwater/fishing-tips/anatomy/> .

#### Water Quality Management

Durborow et al. 1997. Ammonia in Fish Ponds. U.S. Department of Agriculture Southern Regional Aquaculture Center. Publication no: 463.

Durborow et al. 1997. Nitrite in Fish Ponds. U.S. Department of Agriculture Southern Regional Aquaculture Center. Publication no.

Hargreaves and Brunson. 1996. Carbon Dioxide in Fish Ponds. U.S. Department of Agriculture Southern Regional Aquaculture Center. Publication no: 468.

Hargreaves and Tucker. 2002. Measuring Dissolved Oxygen Concentration in Aquaculture. U.S. Department of Agriculture Southern Regional Aquaculture Center. Publication no: 4601

Morgan and Brunson. 2002. Toxicities of Agricultural Pesticides to Selected Aquatic Organisms. U.S. Department of Agriculture Southern Regional Aquaculture Center. Publication no: 4600.

Swann. A Fish Farmer's Guide to Understanding Water Quality. Illinois-Indiana Seagrass Program Aquaculture Extension. Fact sheet AS-503.

USDA. Pond Fertilization: Initiating an Algal Bloom. U.S. Department of Agriculture Western Regional Aquaculture Center. Publication no: 104.

### Recirculating Aquaculture Systems

- Dunning et al. 1998. The Economics of Recirculating Tank Systems: A Spreadsheet for Individual Analysis. U.S. Department of Agriculture Southern Regional Aquaculture Center. Publication no: 456.
- Masser et al. 1999. Recirculating Aquaculture Tank Production Systems: Management of Recirculating Systems. U.S. Department of Agriculture Southern Regional Aquaculture Center. Publication no: 452.
- Losordo et al. 1998. Recirculating Aquaculture Tank Production Systems: An Overview of Critical Considerations. U.S. Department of Agriculture Southern Regional Aquaculture Center. Publication no: 451.
- Losordo et al. 1999. Recirculating Aquaculture Tank Production Systems: A Review of Component Options. U.S. Department of Agriculture Southern Regional Aquaculture Center. Publication no: 453.
- Swann. Potential of Recirculating Aquaculture Systems in the Midwest. U.S. Department of Agriculture Illinois-Indiana Seagrant Program Aquaculture Extension.

### Farm Ponds

- Steeby et al. 1998. Repairing Fish Pond Levees. U.S. Department of Agriculture Southern Regional Aquaculture Center. Publication no: 104.
- Wellborn. 1988. Site Selection of Levee-Type Fish Production Ponds. U.S. Department of Agriculture Southern Regional Aquaculture Center. Publication no: 100.
- Wellborn and Brunson. 1997. Construction of Levee-Type Ponds for Fish Production. U.S. Department of Agriculture Southern Regional Aquaculture Center. Publication no: 101.

### Net Pens

- Masser. 1997. Cage Culture: Species Suitable for Cage Culture. U.S. Department of Agriculture Southern Regional Aquaculture Center. Publication no: 163.
- Masser. 1997. Cage Culture: Cage Construction, Placement, and Aeration. U.S. Department of Agriculture Southern Regional Aquaculture Center. Publication no: 162.
- Swann and Selock. 1994. Cage Culture of Fish in the North Central Region. U.S. Department of Agriculture Illinois-Indiana Seagrant Program. Technical Bulletin no: 110.

### Feed Manufacture and Nutrition

- Robinson and Li. 1999. Catfish Protein Nutrition. Mississippi State University Division of Agriculture, Forestry, and Veterinary Medicine Office of Agricultural Communications. Bulletin: 1090
- Robinson et al. 2001. A Practical Guide to Nutrition, Feeds, and Feeding of Catfish. Mississippi State University Division of Agriculture, Forestry, and Veterinary Medicine Office of Agricultural Communications. Bulletin: 1113

### Handling and Transporting Fish

- Cole et al. 1999. Shipping Practices in the Ornamental Fish Industry. Center for Tropical and Subtropical Aquaculture. Publication no: 131.
- Jensen and Brunson. 1992. Harvesting Warmwater Fish. U.S. Department of Agriculture Southern Regional Aquaculture Center. Publication no: 394.

- Jensen. 1990. Transportation of Warmwater Fish: Equipment and Guidelines. U.S. Department of Agriculture Southern Regional Aquaculture Center. Publication no: 390.
- Jensen. 1990. Transportation of Warmwater Fish: Procedures and Loading Rates. U.S. Department of Agriculture Southern Regional Aquaculture Center. Publication no: 392.
- Jensen. 1990. Transportation of Warmwater Fish: Loading Rates and Tips by Species. U.S. Department of Agriculture Southern Regional Aquaculture Center. Publication no: 393.
- Swann. 1993. Transportation of Fish in Bags. U.S. Department of Agriculture North Central Regional Aquaculture Center. Fact Sheet Series no: 104.
- Watson et al. 2010. Shipping Fishes in Boxes. U.S. Department of Agriculture Southern Regional Aquaculture Center. Publication no: 3903.

### Spawning

- Chapman and Eenennaam. 2007. Sturgeon Aquaculture - Specialized Techniques Determining the Stage of Sexual Maturity in Female Sturgeon for Artificial Spawning: The Egg Polarization Index or PI. University of Florida Fisheries and Aquatic Sciences Department, Florida Cooperative Extension Service, Institute of Food and Agricultural Sciences. Document FA153.
- Rottman et al. 1991. Introduction to Hormone-Induced Spawning of Fish. U.S. Department of Agriculture Southern Regional Aquaculture Center. Publication no: 421.
- Rottman et al. 1991. Capturing, Holding Handling, Transporting, Injecting and Brood Fish for Induced Spawning. U.S. Department of Agriculture Southern Regional Aquaculture Center. Publication no: 422.
- Rottman et al. 1991. Determining Sexual Maturity of Broodstock for Induced Spawning of Fish. U.S. Department of Agriculture Southern Regional Aquaculture Center. Publication no: 423.
- Rottman et al. 1991. Hormonal Control of Reproduction in Fish for Induced Spawning. U.S. Department of Agriculture Southern Regional Aquaculture Center. Publication no: 424.
- Rottman et al. 1991. Hormone Preparation, Dosage Calculation, and Injection Techniques for Induced Spawning of Fish. U.S. Department of Agriculture Southern Regional Aquaculture Center. Publication no: 425.
- Rottman et al. 1991. Techniques for Taking and Fertilizing the Spawn of Fish. U.S. Department of Agriculture Southern Regional Aquaculture Center. Publication no: 426.

### Disease

- Camus. 2004. Channel Catfish Virus Disease. U.S. Department of Agriculture Southern Regional Aquaculture Center. Publication no: 4702.
- Camus et al. 1998. Aeromonas Bacterial Infections — Motile Aeromonad Septicemia. U.S. Department of Agriculture Southern Regional Aquaculture Center. Publication no: 478.
- Durborow. 2003. Protozoan Parasites. U.S. Department of Agriculture Southern Regional Aquaculture Center. Publication no: 4701.
- Durborow and Crosby. Mississippi State University Extension Service. Information Sheet 1390.
- Durborow et al. 1998 Ich (White Spot Disease). U.S. Department of Agriculture Southern Regional Aquaculture Center. Publication no: 476.
- Durborow et al. 1998. Columnaris Disease: A Bacterial Infection Caused by Flavobacterium columnare. U.S. Department of Agriculture Southern Regional Aquaculture Center. Publication no: 479.
- Durborow et al. 2003. Saprolegniasis (Winter Fungus) and Branchiomycosis of Commercially Cultured Channel Catfish. U.S. Department of Agriculture Southern Regional Aquaculture Center. Publication no: 4700.



- Hawke et al. 1998. ESC — Enteric Septicemia of Catfish. U.S. Department of Agriculture Southern Regional Aquaculture Center. Publication no: 477.
- Mitchell et al. 1998. Proliferative Gill Disease (Hamburger Gill Disease). U.S. Department of Agriculture Southern Regional Aquaculture Center. Publication no: 475.
- Lane and Morris. 2000. Biology, Prevention, and Effects of Common Grubs (Digenetic trematodes) in Freshwater Fish. U.S. Department of Agriculture, Iowa State University Department of Animal Ecology. Technical Bulletin Series no: 115.
- Swan and White. Diagnosis and Treatment of “Aeromonas hydrophila” Infection of Fish. U.S. Department of Agriculture Illinois-Indiana Sea Grant Program Aquaculture Extension. Fact Sheet AS-461.

#### Prawns/Shrimp

- Ebeling and Rishel. Performance Evaluation of Geotextile Tubes. Aquaculture Systems Technologies, The Conservation Fund The Conservation Fund Freshwater Institute.
- Hargreaves. 2013. Biofloc Production Systems for Aquaculture. Channel Catfish. U.S. Department of Agriculture Southern Regional Aquaculture Center. Publication no: 4503.

#### Catfish

- Durborow. 2000. Catfish Farming in Kentucky. Kentucky State University Aquaculture Program.
- Morris. 1993. Pond Culture of Channel Catfish in the North Central Region. U.S. Department of Agriculture North Central Regional Aquaculture Center. Fact Sheet Series no: 106.
- Ohs. 2004. Channel Catfish (*Ictalurus punctatus*) Production Methods.
- Ratliff. 2003. Scientists Tackle “off flavor” Catfish. Mississippi State University.
- Robinson et al. 1998. Feeding Catfish in Commercial Ponds. U.S. Department of Agriculture Southern Regional Aquaculture Center. Publication no: 181.
- Robinson et al. 2001. A Practical Guide to Nutrition, Feeds, and Feeding of Catfish. Mississippi State University Division of Agriculture, Forestry, and Veterinary Medicine Office of Agricultural Communications. Bulletin: 1113
- Silva et al. 2001. Processing Channel Catfish. . U.S. Department of Agriculture Southern Regional Aquaculture Center. Publication no: 183.
- Tucker. 1991. Water Quantity and Quality Requirements for Channel Catfish Hatcheries. U.S. Department of Agriculture Southern Regional Aquaculture Center. Publication no: 461.
- Tucker and Ploeg. 1999. Managing Off-Flavor Problems in Pond-Raised Catfish. . U.S. Department of Agriculture Southern Regional Aquaculture Center. Publication no: 192.
- Wellborn. Catfish Farmers Handbook. U.S. Department of Agriculture, Mississippi State University Extension Service. Publication 1549.

#### Hybrid Striped Bass

- Dunning. Aquaculture in North Carolina: Hybrid Striped Bass. North Carolina Department of Agricultural and Consumer Services.
- Dunning and Daniels. 2001. Hybrid Striped Bass Production in Ponds: Enterprise Budget. U.S. Department of Agriculture Southern Regional Aquaculture Center. Publication no: 3000.
- Hodson. 1989. Hybrid Striped Bass: Biology and Life History. U.S. Department of Agriculture Southern Regional Aquaculture Center. Publication no: 300.
- Hodson and Hayes. 1989. Hybrid Striped Bass: Hatchery Phase. U.S. Department of Agriculture Southern Regional Aquaculture Center. Publication no: 301.
- Hodson and Hayes. 1989. Hybrid Striped Bass: Pond Production of Foodfish. U.S. Department of Agriculture Southern Regional Aquaculture Center. Publication no: 303.

- Kohler. 2004. A White Paper on the Status and Needs of Hybrid Striped Bass Aquaculture in the North Central Region. U.S. Department of Agriculture North Central Regional Aquaculture Center.
- Morris et al. 1999. Pond Culture of Hybrid Striped Bass in the North Central Region. U.S. Department of Agriculture North Central Regional Aquaculture Center. Fact Sheet Series no: 107.
- Ludwig. 2004. Hybrid Striped Bass: Fingerling Production in Ponds. U.S. Department of Agriculture Southern Regional Aquaculture Center. Publication no: 302.
- McGinty and Rakocy. 1989. Cage culture of Tilapia. U.S. Department of Agriculture Southern Regional Aquaculture Center. Publication no: 281

### Tilapia

- McGinty and Rakocy. 1989. Cage culture of Tilapia. U.S. Department of Agriculture Southern Regional Aquaculture Center. Publication no: 281
- Popma and Masser. 1999. Tilapia: Life History and Biology. U.S. Department of Agriculture Southern Regional Aquaculture Center. Publication no: 283.
- Rakocy, 1989. Tank Culture of Tilapia. U.S. Department of Agriculture Southern Regional Aquaculture Center. Publication no: 282.
- Rakocy and McGinty. 1989. Pond Culture of Tilapia. U.S. Department of Agriculture Southern Regional Aquaculture Center. Publication no: 280.
- Fornshell. 2001. Settling Basin Design. U.S. Department of Agriculture Western Regional Aquaculture Center. Publication no: 106.

### Salmonids

- Cain and Garling. Trout Culture in the North Central Region. U.S. Department of Agriculture North Central Regional Aquaculture Center.
- Fornshell. 2001. Settling Basin Design. U.S. Department of Agriculture Western Regional Aquaculture Center. Publication no: 106.
- Hinshaw. 1990. Trout Production: Handling Eggs and Fry. U.S. Department of Agriculture Southern Regional Aquaculture Center. Publication no: 220.
- Hinshaw. 1990. Trout Farming A Guide to Production and Inventory Management. U.S. Department of Agriculture Southern Regional Aquaculture Center. Publication no: 222.
- Hinshaw. 1999. Trout Production Feeds and Feeding Methods. U.S. Department of Agriculture Southern Regional Aquaculture Center. Publication no: 223.
- Hinshaw et al. 1990. Budgets for Trout: Production Costs and Returns for Trout Farming in the South. U.S. Department of Agriculture Southern Regional Aquaculture Center. Publication no: 221.
- Kinnunen et al. 1990. Salmonid Egg and Fingerling Purchases, Production, and Sales. U.S. Department of Agriculture North Central Region. Technical Bulletin Series no: 103.
- Ladewig and Morat. 1995. Rainbow Trout. U.S. Department of Agriculture Southern Regional Aquaculture Center. Publication no: 224.
- Crosby et al. 2005. Harvesting Ornamental Fish From Ponds. University of Florida Fisheries and Aquatic Sciences Department, Florida Cooperative Extension Service, Institute of Food and Agricultural Sciences. Document FA-117.

### Freshwater Ornamentals I

- Cole et al. 1999. Shipping Practices in the Ornamental Fish Industry. Center for Tropical and Subtropical Aquaculture. Publication no: 131.
- Crosby et al. 2005. Harvesting Ornamental Fish From Ponds. University of Florida Fisheries and Aquatic Sciences Department, Florida Cooperative Extension Service, Institute of Food and Agricultural Sciences. Document FA-117.
- Crosby et al. 2005. Grading Ornamental Fish. University of Florida Fisheries and Aquatic Sciences Department, Florida Cooperative Extension Service, Institute of Food and Agricultural Sciences. Document FA-118.
- Crosby et al. 2005. On-Farm Transport of Ornamental Fish. University of Florida Fisheries and Aquatic Sciences Department, Florida Cooperative Extension Service, Institute of Food and Agricultural Sciences. Document FA-119.
- Crosby et al. 2005. Preparation of Ornamental Fish for Shipping. University of Florida Fisheries and Aquatic Sciences Department, Florida Cooperative Extension Service, Institute of Food and Agricultural Sciences. Document FA-120.
- Hill and Yanong. 2002. Freshwater Ornamental Fish Commonly Cultured in Florida. University of Florida Fisheries and Aquatic Sciences Department, Florida Cooperative Extension Service, Institute of Food and Agricultural Sciences. Circular 54.
- Kam et al. 2006. Feasibility of Direct Marketing Hawaii's Cultured Freshwater Ornamentals. Center for Tropical and Subtropical Aquaculture. Information Sheet no: 152.
- Livengood and Chapman. 2007. The Ornamental Fish Trade: An Introduction with Perspectives for Responsible Aquarium Fish Ownership. University of Florida Fisheries and Aquatic Sciences Department, Florida Cooperative Extension Service, Institute of Food and Agricultural Sciences. Document FA-124.
- Watson and Shireman. 1996. Production of Ornamental Aquarium Fish. University of Florida Fisheries and Aquatic Sciences Department, Florida Cooperative Extension Service, Institute of Food and Agricultural Sciences. Document FA-35.

#### Freshwater Ornamentals II

- Bailey and Cole. 1999. Spawning the tinfoil barb, *Barbodes schwanenfeldi* in Hawaii. Center for Tropical and Subtropical Aquaculture. Publication no: 136.
- Cole et al. 1999. A Manual for Commercial Production of the Gourami, *Trichogaster Trichopterus*, A Temporary Paired Spawner. Center for Tropical and Subtropical Aquaculture. Publication no: 135.
- Cole et al. 1999. Spawning and Production of the Lemon Tetra *Hyphessobrycon pulchripinnis*. Center for Tropical and Subtropical Aquaculture. Publication no: 142.
- Cole and Haring. 1999. Spawning and Production of the Serpae Tetra, *Hyphessobrycon serape*. Center for Tropical and Subtropical Aquaculture. Publication no: 138.
- Tamaru et al. 1997. A Manual for Commercial Production of the Tiger Barb, *Capoeta tetrazona*, A Temporary Paired Tank Spawner. Center for Tropical and Subtropical Aquaculture. Publication no: 129.
- Tamaru et al. 2001. A Manual for Commercial Production of the Swordtail, *Xiphophorus helleri*. Center for Tropical and Subtropical Aquaculture. Publication no: 128.

#### Marine Ornamentals

- Bronson. Culturing Corals: Rules and Regs. Florida Dept of Agriculture and Consumer Services Division of Aquaculture. DACS-P-01545.

- Ellis. Spawning and Early Larval Rearing of Giant Clams (*Bivalvia*: Tridacnidae). Center for Tropical and Subtropical Aquaculture. Publication no: 130.
- Palmtag and Holt. 2001. Captive Rearing of Fire Shrimp (*Lysmata debelius*). Sea Grant Office, National Oceanic and Atmospheric Administration, U.S. Department of Commerce, Texas A and M University.
- Watson and Hill. 2006. Design criteria for recirculating, marine ornamental production systems. *Aquacultural Engineering*. 34:157-162.

#### Marine Baitfish

- Cassiano et al. 2009. Candidate Species for Florida Aquaculture: Pigfish, *Orthopristis chrysoptera*. University of Florida Fisheries and Aquatic Sciences Department, Florida Cooperative Extension Service, Institute of Food and Agricultural Sciences. Document FA-160.
- Creswell et al. 2007. Candidate Species for Florida Aquaculture: Atlantic Croaker, *Micropogonias undulates*. University of Florida Fisheries and Aquatic Sciences Department, Florida Cooperative Extension Service, Institute of Food and Agricultural Sciences. Document FA-148.
- Ohs et al. 2010. Candidate Species for Florida Aquaculture: Pinfish, *Lagodon rhomboides*. University of Florida Fisheries and Aquatic Sciences Department, Florida Cooperative Extension Service, Institute of Food and Agricultural Sciences. Document FA-168.
- Wallace and Waters. 2004. Growing Bull Minnows for Bait. U.S. Department of Aquaculture Southern Regional Aquaculture Center. Publication no: 1200.

#### Other Important Species

- Avery et al. 1998. Crawfish Production: Production Economics, Pond Construction and Water Supply. U.S. Department of Aquaculture Southern Regional Aquaculture Center. Publication no: 240.
- D'abramo et al. 2004. Semi-Intensive Production of Red Swamp Crawfish in Earthen Ponds without Planted Forage. U.S. Department of Aquaculture Southern Regional Aquaculture Center. Publication no: 2401.
- Davis and Locke. 1997. Culture of Largemouth Bass Fingerlings. U.S. Department of Aquaculture Southern Regional Aquaculture Center. Publication no: 201.
- Engle and Stone. 1996. Baitfish Production: Enterprise Budget. U.S. Department of Aquaculture Southern Regional Aquaculture Center. Publication no: 122
- Gunderson and Tucker. 2000. A White Paper on the Status and Needs of Baitfish Aquaculture in the North Central Region. U.S. Department of Agriculture North Central Regional Aquaculture Center.
- Heidinger. 2000. A White Paper on the Status and Needs of Largemouth Bass Culture in the North Central Region. U.S. Department of Agriculture North Central Regional Aquaculture Center.
- Hill and Yanong. 2002. Freshwater Ornamental Fish Commonly Cultured in Florida. University of Florida Fisheries and Aquatic Sciences Department, Florida Cooperative Extension Service, Institute of Food and Agricultural Sciences. Circular 54.
- Lazur and Chapman. 1996. Golden Shiner Culture: A Reference Profile. University of Florida Fisheries and Aquatic Sciences Department, Florida Cooperative Extension Service, Institute of Food and Agricultural Sciences. Document FA-34.
- Meronek et al. 1997. The Bait Industry in Illinois, Michigan, Minnesota, Ohio, South Dakota, and Wisconsin. U.S. Department of Agriculture Cooperative State Research Education and Extension Service, Georgia Department of Natural Resources Fisheries Section. Technical Bulletin Series no: 105.

- Stone and Thomforde. 2001. Common Farm-Raised Baitfish. U.S. Department of Aquaculture Southern Regional Aquaculture Center. Publication no: 120.
- Stone et al. 1998. Preparing and Stocking Golden Shiner Fry Ponds. U.S Department of Agriculture, University of Arkansas Cooperative extension Program in Aquaculture and Fisheries. FSA9080-1M-12-98N
- Stone et al. Tank Spawning and Hatching of Golden Shiners. 1998. U.S Department of Agriculture, University of Arkansas Cooperative extension Program in Aquaculture and Fisheries. FSA9081-1M-12-98N.
- Tidwell et al. 2000. Species Profile: Largemouth Bass. U.S. Department of Aquaculture Southern Regional Aquaculture Center. Publication no: 722.
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