Aquaculture (A ECL 442/542) Spring 2004

Lecture: MW 1:10-2:00 (119 Science II)
Lab: W 2:10-5:00 (141 Science II)

Instructor

Dr. Joseph E. Morris, Department of Natural Resource Ecology and Management (NREM)
Office: Science II, Rm. 111
Email: jemorris@iastate.edu
Phone: 294-4622
Office Hours: M 2:00-3:00; Th 9:00-10:00 or by appointment

Textbook

Wedemeyer, G., editor. 2001. Fish Hatchery Management, 2nd edition. American Fisheries Society, Bethesda, Maryland. Note: this text is noted as FHM in lecture schedule.

Other Readings

Extension fact sheets and bulletins, and non-copyrighted government publications will be used for other topics. Duplication costs will be added to the course fee.

Course Fee

A fee of $30 is charged to cover expenses for duplication of course materials and expenses for use of University vans for field trips (University bill for tuition and fees).

Attendance

Lecture attendance is expected, but if you miss a lecture, handouts, if provided, can be obtained from me. Labs and field trips are required components of the class. Obviously, we cannot facilitate make up for a field trip, and generally, it is not possible for the instructor to redo a lab because the prep time is too extensive.

Field trips

Two or three required field trips will be taken. Trips are scheduled to the Iowa DNR Manchester Hatchery (January) and Rathbun Hatchery (April) to study the production facilities, as well as observe and participate in spawning of rainbow trout (Manchester) and walleye (Rathbun). Field trips will be on Wednesdays, and they will take all day. Departure times will be announced in class. We return about 6 p.m. the same day. Please inform your other instructors in advance of your absence. If requested, I will write an explanation for your absence.

Quizzes, questions, and other items

There will be announced quizzes, and questions on reading assignments, or lab activities.

Assigned Readings

The required readings are from the text or handouts. In addition to those readings listed in the lecture schedule, additional readings will be announced the week prior to the related lecture. Since many of these readings are actually extension publications, I have produced a CD with numerous USDA publications for your use.

Grading

A ≥ 92% A- ≥ 90% B+ ≥ 88% B ≥ 82% B- ≥ 80% C+ ≥ 78%
C ≥ 72% C- ≥ 70% D+ ≥ 68% D ≥ 62% D- ≥ 60% F < 60%

Exams	150 pts
Lab Reports/Exercises	50 pts
Term Paper	50 pts
Total	**200 pts**

Course Description from ISU catalog

Concepts related to the culture of aquatic organisms including culture systems, water quality, nutrition, genetics, and diseases.

Aquaculture Definition

- The business of fish farming. Note, however, that not all of aquaculture organisms are fish (that is, vertebrate animals that respire by means of gills); aquaculture also includes aquatic plants (e.g., marine algae), crawfish and shrimp, which are crustaceans, and oysters, mussels, clams, and abalone, which are mollusks.

- The production of aquatic organisms, both plant and animal, in marine or freshwater, but distinguished from commercial wild harvest by the fact that aquaculture product is produced under controlled or semi-controlled conditions. The “controlled or semi-controlled conditions” distinguishes aquaculture from traditional “hunt-and-capture” fishing of wild stocks of marine and freshwater fish, shrimp, and shellfish.

Note that aquaculture includes aquatic plants (e.g., nori, is a type of marine algae), but not terrestrial plants (basil, tomatoes, lettuce, etc.) raised in a hydroponic system. Hydroponics is defined as the cultivation of terrestrial plants in nutrient solution rather than in soil. Although fish culture and hydroponics are sometimes coupled, that is, effluent from the fish culture facility is used for raising terrestrial plants, hydroponics is not aquaculture and conversely, aquaculture is not hydroponics.

Subject Matter:
1. Principles, concepts and terminology related to cultural technology of aquatic organisms in standing (also called extensive culture, or pond-culture) and flowing water (commonly called intensive culture, which is done in tanks or raceways, using single-pass, reuse, or recycle culture systems), or in netpens or cages.
2. Topics related to water quality requirements, disease, nutrition, genetics, and reproductive biology, and transportation.
3. Cultural technology for selected aquaculture species, including channel catfish, hybrid striped bass, rainbow trout, sunfishes, black basses, minnows (fathead and golden shiners), yellow perch, walleye, crawfish, and freshwater shrimp.

Outcomes

1. Enhanced understanding through lectures, study, and experiences (field trips and laboratory activities of 1) principles, concepts and vocabulary related to cultural technology of aquatic organisms in standing (also called extensive culture, or pond-culture) and flowing (commonly called intensive culture, which is done in tanks or raceways, using single-pass, reuse, or recycle culture systems) water, or cages culture, 2) factors of water quality, disease, nutrition, genetics, and reproductive biology that are of importance to aquaculture, and 3) cultural technology specific for selected aquaculture species, including channel catfish, hybrid striped bass, tilapia, rainbow trout, crawfish, sunfishes, black basses, minnows (fathead and golden shiners), percid fishes, and shrimp.
2. Develop skills for (1) conducting a computerized literature search (searching computerized databases to find references) for a term paper; (2) writing a manuscript in journal format (North American Journal of Aquaculture); (3) conducting statistical analysis of aquaculture data using commercial statistical software; and (4) spawning fish, (5) anesthetizing fish for marking and tagging, (6) conducting water quality assessment.

Lecture exams (150 points)

There will be two 1-hour lecture exams (45 points each) as well as a comprehensive final exam (60 points). Exam questions will come from lecture, readings, and handouts. The exams will consist of multiple choice, fill in the blank and short answer; they will also involve problem solving. A hand calculator that has log functions is required for lab, doing problems in class and for exams.

Makeup Exam: A student who misses an exam must request a makeup exam in writing. If the reason for missing the exam is acceptable, a makeup exam may be given during the finals week (date and time to be arranged). The makeup exam will not be same exam as given to the rest of the class. Anyone who misses an exam and fails to arrange for a makeup exam will receive 0 points for the exam.

Laboratory reports (100 points)

The lab grade will be based on your lab reports. Reports include data collection from field trips and analysis done in class at later date. **Attendance and participation in lab is required.** Points are subtracted for missed classes: 50% off for missed labs or poor participation.

Assignments

During the course of the lecture, assignments will be given to students that will exemplify the principles noted in the lecture materials. While these assignments will **not** be graded, it is in the best interest of the student to complete them in preparation for upcoming exams.

Term Paper (50 points)

Task	Due Date	Points
1. Title	Jan. 28	5
2. Literature review	Feb. 18	5
3. Outline	March 24	10
4. Final copy	April 28	25
5. Presentation	April 281	5
		50

1. Title
   Chose a relatively specific topic, but one that you can find related information about aquaculture; a paper on the life and times of the bluegill is **not** an appropriate topic. Prior approval of the topic is required. Any departures from the agreed upon topic must have prior approval from the instructor, otherwise, this exercise will have 0 points.

Suggested Topics for Term Papers in AECL 442/542 Aquaculture

Genetics

- Procedures for genetic engineering of fish.
- Ethical issues involved in genetic engineering of plants, fish and other animals.
- Pros and cons of fish hybridization and its application to aquaculture.

Growth

- Influence of the onset of maturation on growth rates of cultured fish.
- Comparative growth rates of wild and cultured yellow perch (or walleye, bluegill, etc.).

Nutrition

- Lipid oxidation in fish feeds: Biochemistry, measurement, and effects on fish health.
- Protein/energy ratios in commercial and experimental diets.
- Energy requirements for fish growth: Effects of temperature and fish size.
- The use of feeding stimulants in aquaculture.
- Dietary supplements to enhance color, prevent skeletal deformities, enhances growth, reproductive fitness, and immuno-competence.
- Anti-nutritional factors for fish in fish feed ingredients
- Methods for the development of feeding rate tables for fish.
- Importance of nutritive variation in brine shrimp for culture of larval fish.

Physiology

- Influence of stress on growth rates of fish.
- Heritability of low stress
- Measures of stress and application to aquaculture

Disease

- Vaccines for viral (or bacterial, or protozoan) diseases of fish
- New animal drugs

Other

- Organic standards for cultured fish.
- Fish hatchery effluents: nitrogen and phosphorus discharge.
- EPA regulation of fish hatchery effluents

2. List of references

A list of $\geq$ 5 peer-reviewed references for your term paper is required. They must be typed in the format specified by the American Fisheries Society (AFS). See any AFS journal - they all follow the same format. Unless otherwise informed a web site is not an acceptable peer-reviewed publication. Point values will be assessed in accordance to the effort and format of this exercise.

Journals of the American Fisheries Society

- Transactions of the American Fisheries Society
  -basic fisheries science
- North American Journal of Fisheries Management
  -fisheries management research
- North American Journal of Aquaculture
  - breeding and culture of aquatic animals
- Journal of Aquatic Animal Health
  -health maintenance and disease treatment

3. Outline

The more detail presented, greater the point value as well as ease in completing the final draft.

4. Final copy
   Detailed instructions for term papers are provided in a handout. **Warning:** a term paper that has been used in another class (e.g., Fish Biology, Aquatic Ecology, Fishery Management) is not acceptable. All papers are to be sent to my email address; they will be graded and returned to you for your information.

5. Presentation
   Students will present their presentations during the scheduled class time on April 28. The presentations will be limited to 5 minutes with 1-2 minutes for discussion.

Class Schedule

Week	Date	Topic	Term Paper Dates
		Background Information	
1	Jan. 12	• Pre-Test • Introduction to scope of course: field trips, exams, term papers, etc. • Preparation for Manchester Trip	
	14	• Lab 1: Field trip to IDNR Manchester Fish Hatchery (300 miles round trip) to examine hatchery facilities and spawning, egg incubation and rearing of trout (9:00 a.m.-6:00 p.m.) • Take home quiz on Leitritz and Lewis (1980) – Spawning trout.	
2	19	• Turn in take home quiz covering field trip to Manchester Hatchery • Discuss quiz and questions about field trip.	
	21	• Lab 2: Does not meet	
	21	• Term paper and how to do a computerized literature search – searching ISU Library Indexes & Abstracts http://www.lib.iastate.edu/collections/db/indexabst_name.html AGRICOLA, American Fisheries (ABSEARCH, Inc.), Biological Abstracts Fish and Fisheries Worldwide, Water Resources Abstracts, Web of Science, and Zoological Record • Lecture: History and Scope of Aquaculture • Reading: 1) Log on to the 1998 Census of Aquaculture for statistics (http://www.nass.usda.gov/census/census97/aquaculture/aquaculture.htm). • 2) FHM 241-242, 266-282	
3	26	• No Class	
	28	• No Class	
	28	• Lab 3: Lecture: Water supply for aquaculture: quantity and sources: Surface and ground water resources. Reading: 1) FHM, pp. 110-115.2) Glandville, T. D. 1993. Good Wells for Safe Water. Cooperative Extension Service, ISU, Ames. Pm 840. http://www.extension.iastate.edu/Publications/PM840.pdf • Lecture: Water quality for aquaculture: Temperature, DO, and Oxygen supplementation Reading: FHM, pp. 35-36, 46-47, 92-100	Paper Title
4	Feb. 2	• Lecture: Water quality for aquaculture: Temperature, DO, Oxygen supplementation, dissolved gas supersaturation. Reading: FHM, pp. 35-36, 46-47, 92-100, 106-107, 141-146	
	4	• Lecture: Fish Harvest and Transportation Reading: Fish Transportation by Carmichael et al. pp. 641-660 in Fish Hatchery Mgt, 2nd edition.	
	4	• Lab 4: Water quality for aquaculture: 1) Chlorine, 2) Nitrogen compounds: ammonia, nitrite and nitrate Reading: FHM, Chlorine pp. 71-72, 108, nitrogen compounds pp. 38-39, 101-105	
5	9	• Lecture: Fish nutrition: Nutritive requirements of fish, and fish feed and feeding. Reading: FHM pp. 483-556.	
	11	• Lecture: Fish health management. Reading: FHM pp. 559-638 Videos: fish diseases	

	11	• Lab 5: Water quality for aquaculture: 1) pH, C02, alkalinity, hardness, salinity and salt, Solids: settleable solids, suspended solids, and dissolved solids Reading: FHM, C02,36-38, 96-101, 105-106	
6	16	**Exam I**	
		Production Systems	
	18	• Lecture: Ponds – Design	Lit. Review
	18	• Lab: 6: Pond Design	
7	23	• Lecture: Ponds – Fertilization/Vegetation Management	
	25	• Lecture: Raceways	
	25	• Lab 7: Invertebrate Management	
8	March 1	• Lecture: No Class, 2004 WAS Conference	
	3	• Lecture: Aquaculture Using Saline Groundwater	
	3	• Lab: 8 Lab does not meet, 2004 WAS Conference	
9	8	• Lecture: Net Pen Culture	
	10	• Lecture: Recycle Systems	
	10	• Lab 9: Design of Recycle Systems	
10	14-18	Spring Break	

11	22	**Exam II**	
		Taxa-Specific Culture (modified)	
12	31	• Lecture: Warm water fishes — Channel catfish Reading: SRAC180-192; 1800-1801; NCRAC 106	
	31	• Lab 12: Field trip to ponds and catfish videos	
13	April 5	• Lecture: Minnow Baitfish Culture Reading: SRAC 120-124	
	7	• Lecture: Tilapia Culture Reading: SRAC 280-283	
	31	• Lab 13: 1) Fish Farm: Computer simulation model of catfish farming; 2) Analysis of Fish Farm data with JMP – stat program 3) fish growth analysis	
14	12	• Lecture: Culture of black basses and sunfish Reading: SRAC 201, 202, 722, 724	
	14	• Lab 14: Field trip to Rathbun Hatchery for walleye spawning and study tour of production and research facilities. Lv 7;30 a.m. – return by 5 p.m.	
15	19	• Lecture: Culture of Hybrid Striped Bass Readings: SRAC 300-304, 3000; NCRAC 107 Videos: (1) Producing Striped Bass in Hatcheries (16 min) and (2) Southern Hybrid Striped Bass Production in Ponds (15 min)	
	21	• Lecture: Walleye and Yellow Perch Readings: NCRAC 111	
	21	• Lab 15: No Lab	
16	26	• Lecture: Salmonids Readings: SRAC 220-224	
	28	• Lecture: Shrimp and Crawfish Culture Readings: 240-244; 260; 2600	
	28	• Lab: 16 Presentations	Final Draft

Final exam week, Monday-Friday, May 3-7—for Monday, May 3, 12:00-2:00 p.m. in Room 119 Science II (see http://www.iastate.edu/~registrar/exams/tentexam.html for final exam schedule.

Production Plan (Graduate Students - valued at 50 points for a total of 250 total points).

During the semester you will prepare a written production plan for a hatchery. The goal of this plan is to compare and contrast public and private sectors in regard to hybrid striped bass production. Your plan will be evaluated for soundness of data interpretation, technical merit (how reasonable and effective is the management plan), and communication effectiveness; each of these elements will count equally to the management plan grade. I will grade the production plan and assign separate grades for data interpretation, technical merit, and communication effectiveness. The grade on the management plan will be the arithmetic average of all grades assigned to the plan.