

**Limnology Lab – Ecology of Fishes**  
**Zoology and Environmental Studies 511**  
**\*Sample Syllabus\***

**Course Objectives:** ZOO 511 will cover aspects of fish anatomy, biology, and taxonomy, with a primary focus on the fish ecology of the fishes of Wisconsin. Instruction will encourage a thorough understanding of the elements that affect fish and fish populations including physical attributes, the environment, and interactions among fishes and between fishes and their surroundings. We will encourage critical thinking and understanding how concepts connect throughout the course. We'll accomplish this with reading and summarizing primary literature, identifying species, field trips, and writing a comprehensive term paper. Lab activities will include dissections, diet analysis, direct observation, computer simulations and more.

**Class Goals** – during this class you should:

- gain experience/improve your scientific writing skills
- gain experience/improve your ability to think and problem solve as an ecologist
- gain experience in several fisheries sampling, laboratory and data analysis techniques
- gain experience working through a research project from sampling design to writing
- gain exposure to concepts in fish evolution and the diversity of fishes, with an emphasis on fish of WI

**Readings** – Some classes will include discussion on a peer-reviewed article that you have read. These articles will represent either classic research that led to how we currently think about various aspects of fish ecology, or they will report cutting-edge advances in the field. We will discuss these papers on the date they are assigned and may give short quizzes on main concepts from the articles. The goals of these assignments are to expose you to the cornerstone works of fish ecology, increase your comfort level with scientific writing, allow you to practice critical reading and thinking and give you suitable examples for your own scientific term paper. Readings currently listed on the syllabus are subject to change with sufficient notice.

**Fish identifications** – You will be expected to be able to identify a subset of the fish species and fish families that are present in Wisconsin, and know the common names of all species and the scientific names of only several species (the family names, such as Centrarchidae, are “scientific”).

**Field Trips** - There are two field trips during the semester. The first is to a classic spring-fed Wisconsin trout stream and will provide the data for your scientific paper. You'll collect and analyze the data and write a paper based on a hypothesis that you develop. The other field trip will most likely be to the Willow Creek tributary to Lake Mendota (on the UW campus). This field trip is scheduled late in the semester and will expose you to more fish collection methods and a diversity of fish species. Field trip dates may be changed last minute based on weather and conditions. Field trips will require that we leave slightly earlier (1:00pm), and we may get back slightly later than the normal class periods. We'll do everything we can to make it back by 5:00pm. Students must attend field trips on their regular lab day. Remember to dress appropriately for the conditions. You do not need your own waders for the class, but students who have chest waders may bring their own for the field trips.

### **Term Paper**

This course emphasizes writing more than most science courses you may have taken. Class exercises will explore literature searching, idea development, pattern recognition, statistical analyses, and the art of scientific writing. You will write two drafts of a scientific paper, review a paper from your peers, and give a presentation of the material in your paper. ***Anticipate spending a significant amount of time on this project.***

### **Exams**

There will be two in-class exams. Exams will be based on fish identification, analysis of figures, lectures, readings, and discussion. Exam questions will be short-answer or fill-in-the blank in a lab practical format.

## **Sample Assignments**

### *Assignment 1: Ecology of “your” fish*

Each student is assigned a freshwater and marine fish (you will receive your assignment in lecture). In this assignment we want you to demonstrate that you can find, interpret and assimilate primary literature (real papers, not websites) relating environmental and biological aspects of ecology to your particular species.

### *Assignment 2: Create your own key*

You will develop and design your own key to the families from the first half of Wisconsin fishes you are required to know for the exams. This will give you the opportunity to apply what you know about fish evolution and functional morphology as well as help you study your fish identifications for the practical.

### *Assignment 3: Review a peer’s paper*

The peer review process is critical to the progress of science. More often than not your peers will have valuable insight regarding your research that you may not have considered. As scientists, we send our papers through both a friendly (scientists we know) and official (journal editors) review process. You will experience both the roles of reviewer and reviewee by exchanging paper drafts and reviewing a classmate’s paper while yours is also being reviewed.

### *Assignment 4: Bioenergetics Exercise*

Bioenergetics 3.0 is a program developed here at UW-Madison by researchers in the Center for Limnology. It uses known species-specific physiological characteristics and allows you to input attributes of fish that you’ve measured, such as growth. You can then explore various aspects of ecology to understand how variables such as water temperature or food consumption influence fish metabolism and growth.

## **Research Project**

You will complete an original research project from start to finish. You will collect data (on our Badger Mill Creek field trip), create hypotheses, present a proposal for the project to your classmates, analyze your data and draft a scientific manuscript (you’ll submit 3 drafts total). Along the way you will review a proposal and paper from your classmates (Assignment 3) to provide them with suggestions for improving their project. You will also benefit from feedback that your peers give you, which you are expected to incorporate into your research approach.

## **Plagiarism**

Plagiarism will not be tolerated. Consequences will be severe and all cases will be reported to the Dean of Students office. If you need clarification on what constitutes plagiarism see <http://writing.wisc.edu/Handbook/QuotingSources.html>. Science is a collaborative effort and we encourage students to work together on assignments/projects. However if you do work collaboratively, you need to indicate the names of the people you worked with on that assignment, and your final product must be your own original work.

### Sample Grading Scale:

Your grade will be based on exam scores, the scientific paper, quizzes, assignments and class participation.

<u>Item</u>	<u>Points</u>
Midterm Practical	60
Final Practical	60
Quizzes (4 total, 10 points each)	40
Scientific Research Project	
Hypotheses	5
Proposal & Bibliography	10
First Draft (for peer review)	20
Second Draft (for TA review)	30
Final Draft	50
Presentation	20
Assignment 1: Ecology of your fish	20
Assignment 2: Create a dichotomous key	20
Assignment 3: Review a peer's paper	15
Assignment 4: Bioenergetics	30
<u>Class Participation</u>	<u>20</u>
<b>TOTAL</b>	<b>400</b>

### SAMPLE WEEKLY TOPICS

#### *Week 1*

Lecture: TA and student introductions, Fish Anatomy, intro to wisfish, fishbase and Becker Key  
Lab: Dissections, learn internal and external anatomy  
Assignments & Readings: None

#### *Week 2*

Lecture: Evolution and Functional Morphology, First ½ of WI Fishes list, how to find and read articles (web o' science and Google Scholar)  
Lab: Observation, describe differences in the morphology of the first ½ of WI fish families  
**Assignments:** Ecology of Your Fish (due week 3), Construct Your Own Key (due week 4)  
**Readings:** None

#### *Week 3*

Lecture: Age and growth  
Lab: Scales, otoliths & calculating growth  
**Assignments:** Remember Construct Your Own Key is due week 4  
**Readings:** Kitchell 1977 on bioenergetics modeling (for Quiz 1 next week)  
**ECOLOGY OF YOUR FISH DUE**

#### *Week 4 TAKE QUIZ 1*

Lecture: Bioenergetics, Electrofishing techniques and safety  
Lab: Bioenergetics modelling, discuss Kitchell 1977  
**Assignments:** Bioenergetics assignment (due week 6)  
**CONSTRUCT YOUR OWN KEY DUE**

**Week 5 FIELD TRIP ARRIVE AT 1pm**

BADGER MILL CREEK FIELD TRIP

**Assignments:** hypotheses/questions for research project (due at the end of lab week 6)

**Readings:** TBD

**Week 6**

Lecture: Organizing and analyzing data in Excel, scientific communication

Lab: Data entry & statistics in Excel, **finalize hypotheses/questions** (submit today and your TA will return comments to you before the weekend)

**Assignments:** Short (1-1.5 page) research proposal with bibliography (due week 7)

**BIOENERGETICS ASSIGNMENT DUE**

**Week 7**

Lab: Global fish diversity; group discussion of proposals

Optional review for midterm exam – TAs available for review, questions, etc. In prior years, students attending optional review sessions have performed better on the exam.

**Assignments:** study for midterm exam! First draft of paper due Week 10 (Apr. 1,2)

**PROPOSAL DUE**

**Week 8**

**MIDTERM EXAM**

**Assignments:** First draft of paper due Week 10 (Apr. 1,2)

*Spring Break, No Class*

**Week 9**

Lecture: Foraging and diets

Lab: Diet analysis

**Assignments:** First draft of paper due week 10

**Readings:** Carpenter and Kitchell 1985 on trophic cascades in lakes (for Quiz 2 next week)

**Week 10 TAKE QUIZ 2**

Lecture: Population dynamics, the peer review process

Lab: Mark recapture, discuss Carpenter and Kitchell reading

**Assignments:** Peer review assignment (due week 11)

**Readings:** Moyle and Light 1996 on biological invasions of freshwater (for Quiz 3 next week)

**PAPER FIRST DRAFTS DUE**

**Week 11 TAKE QUIZ 3**

Lecture: Exotics and communities, 2<sup>nd</sup> half of WI fish species, scientific writing & revising

Lab: Observing fish from the second half of the list, discuss Moyle and Light 1996

**Assignments:** Second draft of paper due Week 12

**PEER REVIEW ASSIGNMENT DUE**

**Week 12 FIELD TRIP ARRIVE AT 1pm**

FIELD TRIP LOCATION TBD

**Assignments:** Final presentations on Week 14. Final draft of paper, hardcopy (w/ drafts attached) due by **5 pm Monday May 12<sup>th</sup>**

**Readings:** Worm et al. 2006 on global fisheries collapse (for Quiz 4 next week)

**PAPER SECOND DRAFTS DUE**

### **Week 13 TAKE QUIZ 4**

Lecture: Fisheries crisis & fishery techniques

Lab: Discuss Worm et al., Meet w TA re. paper drafts

**Assignments:** Final presentations next week

### **Week 14**

Lecture: Final project presentations; final exam review

Lab: Play "Fish Jeopardy" to review for final

**Assignments:** Study for final! And write the paper!

### **Week 15**

#### **FINAL EXAM**

**Assignments:** **Final draft of paper** (hardcopy w/ all drafts attached) due by **5pm**

#### **Suggested References**

Though there is no textbook for this course, these books are great references on the topic of fish ecology.

Becker, G.C. 1983. The Fishes of Wisconsin. University of Wisconsin Press. Madison, WI.

Available Online: <http://digicoll.library.wisc.edu/cgi-bin/EcoNatRes/EcoNatRes-idx?id=EcoNatRes.FishesWI>

Barton, M. 2007. Bond's Biology of Fishes (3rd edition). Thomson, Belmont, CA.

Bosanko, D. 2007. Fish of Wisconsin Field Guide. Adventure Publications, Inc. Cambridge, MN.

Diana, J.S. 2004. Biology and Ecology of Fishes (2nd edition). Biological Sciences Press.

Evans, D.H. (Ed.). 1993. The Physiology of Fishes. CRC Press. London.

Guy, C.S. and M.L. Brown (editors). 2007. Analysis and Interpretation of Fisheries Data. American Fisheries Society. Bethesda, MD. (currently available in CFL library only)

Helfman, G.S., B.B. Collette, and D.E. Facey. 1997. The Diversity of Fishes. Blackwell Science, Inc. Malden, MA.

Helfman, G.S. 2007. Fish Conservation. Island Press, Washington, D.C.

Matthews, W.J. 1998. Patterns in Freshwater Fish Ecology. Chapman & Hall. New York, NY.

Moyle, P.B., and J.J. Cech. 1996. Fishes: An introduction to Ichthyology (5th edition). Prentice Hall. Saddle River, NJ.

Scott, W.B. and E.J. Crossman. 1973. Freshwater Fishes of Canada. Bulletin 184, Fisheries Research Board of Canada.

Wootton, R.J. 1990 Ecology of Teleost Fishes. Chapman and Hall. London.

#### **Great websites:**

Wiscfish: <http://www.wiscfish.org/fishid/> Google Scholar: <http://scholar.google.com/>

Fishbase: <http://fishbase.org/> Web of Knowledge: <http://apps.isiknowledge.com/>