Freshwater Science 650
Ecology of Aquatic Invertebrates

Jerry L. Kaster, Ph.D.
School of Freshwater Sciences
jlk@uwm.edu (highlight with ‘STUDENT’ on subject line.)
Class location: SFS, classroom 1084
Lec Th 9:30AM-12:10PM
Office Hours: Th 12:30 and by appointment or email or contact me during class.

TEXT
Ecology and Classification of North American Freshwater Invertebrates, 3rd Edition
Edited by James H. Thorp and Alan P. Covich 2009. $139.95 (Amazon $55-$85)

Class Description: Ecological dynamics of aquatic invertebrate interactions with emphasis on the Great Lakes, but including inland lakes, rivers, and marine systems.

GOALS OF THIS COURSE
Aquatic ecology can be a fascinating, but often challenging field of study, as the processes and organisms are not always readily observable. Most people have some exposure to the wide diversity of freshwater habitats around them. These habitats form an integral part of the cycle of life on our planet, and are generally a joy and wonder to study. (Plus, you get to be in and around streams, lakes and rivers, and who doesn’t enjoy that?) In this course you will learn much about the freshwater invertebrate ecology in Lake Michigan, and local lakes and streams. You will learn about the physical, chemical and biological processes that create, shape and how they interact with aquatic invertebrates. In addition you will learn how to study these systems as well as learn to identify major groups of aquatic invertebrates within the systems. I hope, at the end of the semester, you will have a rich appreciation for the fresh water flowing in, around and through our lives.

By the end of this course, you should:
- be able to identify aquatic invertebrates to genus and use invertebrates to ask ecological or environmental conservation questions, e.g. pollution ecology.
- understand the phylogeny, life histories, behaviors, trophic importance, adaptations to life in water, and conservation significance of aquatic invertebrates.
-be familiar with methods for measuring invertebrate density, biomass, production, disturbance/stress vectors and other ecological measures, e.g. diversity.
-be able to use invertebrate bioassessment protocols to test for environmental impacts.

ESTIMATED STUDENT WORKLOAD
The estimated workload for activities associated with the course are as follows:
Attendance at lectures 20 hours
Attendance at lab 24 hours
Reading assigned material 42 hours
Exam preparation 16 hours
Project work 20 hours
Six assignments for all students 24 hours
Total 146 hours

GRADING
The University grading scale will be used.
http://www4.uwm.edu/secu/acad+admin_policies/S29.htm

EXAM SCHEDULE
Lec Exam I, 7 week
Lab Exam I, 7 week
Lec Exam II, 15 week
Lab Exam II, 14 week

Exam Point Distribution: Each Lec & Lab Exam will be 100 points.

GRADUATE STUDENT REQUIREMENT – Research project, presentation, and paper
All graduate students in the class will be expected to conduct, write up and give an oral report on an independent research project regarding freshwater ecology. There will be two weeks during the second half of the semester in which the laboratory section of the class will be available for work on the projects. Projects may be done in pairs (actually this is encouraged) BUT each student will write their own 1600-2000 word research paper (double spaced, 12 point font, not including references or graphs/charts/figures) DUE ON THE LAST DAY of the regular term. Research Presentations will be given to the class during lab section of the last two weeks of the semester and can be done in teams, although all students MUST participate equitably in the reporting.

The research paper must follow the standard scientific research paper format and include the following items:
A. Abstract (approx. 10 sentence summary of project) (should be its own page)
B. Introduction (a general literature review of the topic ending with an introduction of the research)
C. Methods (description of, where, when, how the research was conducted)
D. Results (what was found by your study)
E. Discussion (what your results mean and how they fit into the general scheme you
laid out in the introduction and how you might change things if you were to do it over.

F. List of peer-reviewed references (research papers and books) cited in the report

G. Figures graphs or charts that enhance the readers understanding of the project (avoid 3-d and pie charts unless absolutely necessary)

You will have 15 min total for the oral report (12 for the report and 3 for questions) in which you will summarize for the rest of the class what you did, why you did it, what you found and why your results are interesting. Your report should start with an introduction to your research and why it’s interesting, provide the details of the research, and then summarize the results and conclusions.

All projects MUST BE APPROVED BY ME BY February 10th. STUDENTS MUST TURN IN AN ABSTRACT PARAGRAPH DESCRIBING WHAT YOU PLAN TO DO BY February 3rd. This means that you must develop an idea BEFORE you start work. You can therefore start work early in the semester if you desire.

You will use the invertebrates you collect and identify as part of your invertebrate collection and to answer an ecological or conservation oriented question. You are required to turn in a paper that describes the project in a standard scientific format, with appropriate graphs, tables, and references. You are required to defend your work in an oral presentation. In addition, you are required to turn in a collection of voucher specimens (representative specimens of the taxa, identified to lowest practical taxon, that you find at each site). The collection will be an important product from the course demonstrating your mastering of aquatic invertebrate taxonomy, and the paper will demonstrate your ability to synthesize and interpret ecological data using invertebrates. More detailed instructions on the collection and papers will be provided, and I will work with you to develop field methods and provide directions on how to do the appropriate data analyses, find relevant references, etc. Potential group projects include, but are not limited to: Investigating possible changes due to climate, land use, etc. of the distribution of aquatic invertebrates along a lake/stream continuum. There are a number of current impacts on aquatic systems (e.g., effluent, land development, dams, etc.) that would be good topics for a biomonitoring project investigating possible effects on invertebrate ecology and water quality of Lake Michigan, streams, or wetlands.

REQUIRED READING
Current readings will be assigned and discussed in class.

FIELD WORK
Field trips will generally occur regardless of the weather other than impracticality (e.g. high water) or storm watch/warning. You are responsible for providing your own clothing (e.g. rain gear, waders). Collecting trips will involve Lake Michigan ship time, and hiking to streams, wetlands, and lakes. Students must bring their own waders on days required. Students should also bring a raincoat, a appropriate clothing, daypack, water bottles, and a snack is encouraged.
ITEMS TO BE PURCHASED
● 50 scintillation vials (UWM Bookstore)
● 1 pair soft forceps (Bioquip Featherweight forceps, Item: 4750, www.bioquip.com)
● 1 pair hard forceps (Bioquip Featherweight forceps, Item: 4531, www.bioquip.com)
● Waders and rain gear

TIME TABLE & TOPICS
WEEK 1 (Jan 27)
  Lec:
  1. Course info
  2. Brief history and overview of aquatic invertebrate ecology
  3. Introduction to aquatic invertebrates and their habitats
  Lab: Process samples from field trip and laboratory invertebrate synopsis

WEEK 2 (Feb 3)
  Lec: Freshwater origins and evolution of aquatic invertebrates
  Field trip: Invertebrate sampling and collecting for project and collection
  Lab: Process samples from field trip, work on collection, learn about taxa collected, and laboratory invertebrate synopsis

WEEK 3 (Feb 10)
  Lec: Overview of Lake Michigan invertebrates
  Field trip: Lake Michigan sea trip. Invertebrate sampling, grabs.

WEEK 4 (Feb 17)
  Lec: Aquatic invertebrate - lotic systems
  1. Substrate relations
  2. Hyporheic processes and issues
  Field trip: Lake Michigan weather day
  Lab: Process samples from field trip, work on collections, and laboratory invertebrate synopsis

WEEK 5 (Feb 24)
  Lec: Aquatic invertebrates – lotic systems
  1. Syton – periodicity; catastrophic/non-catastrophic
  2. Invertebrate/habitat continuum concept
  Field trip: Invertebrate sampling – lentic systems
  Lab: Process samples from field trip; laboratory invertebrate synopsis
WEEK 6 (Mar 2)
Field trip: Invertebrate sampling – lentic systems
Lec: Pollution ecology
1. Biological assessment - theory and methods
2. Using invertebrates as indicator organisms
Lab: computer lab to calculate indices and estimate species diversity; laboratory invertebrate synopsis

WEEK 7 (Mar 9)
  Lecture Exam 1
  Lab Exam 1

WEEK 8 (Mar 16) Spring break

WEEK 9 (Mar 23)
Lec: Autecological relationships I
1. Patterns of aquatic invertebrate populations
2. Introduction to functional trophic groups
Lab: Student Presentation; 2°Production calculations; trophic interaction lab

WEEK 10 (Mar 30)
Lec: Autecological relationships II
1. Colonization dynamics – modeling
2. Predation linkages between terrestrial and aquatic food webs
3. Predation and Competition
Lab: Student Presentation;

WEEK 11 (Apr 6)
Lec: Synecological relationships I
1. Patterns of aquatic invertebrate communities
2. Biotic interactions and community ecology
3. Intermediate disturbance and abiotic vs biotic dynamics
Lab: Student Presentation; measuring disturbance and response

WEEK 12 (Apr 13)
Lec only (fall break): Aquatic invertebrate behavior (feeding behavior, defensive behavior, dispersal behavior)

WEEK 13 (Apr 20)
Lec: Synecological relationships II
1. Modulated disturbance; abiotic vs biotic dynamics
2. Hierarchy- invertebrate mediated system growth and collapse
Lab: Hierarchy modeling
WEEK 14 (Apr 27)

Lec: Interdisciplinary linkages: engaging new frontiers in aquatic invertebrate ecology
Lab Exam 2

WEEK 15 (May 4)

Review

FINAL

Lecture Exam 2

POSSIBLE EXERCISES - (and study questions) associated with lab and field studies:

- Experiment on cased-caddisfly movement testing the direction and magnitude (ie distance) of movement. The study will mark individual caddisfly cases using a semi-permanent marker (nailpolish) and then recapture them at a later time.
- Using simple zooplankton nets to collect organisms, the study will either examine daily patterns in abundance or spatial patterns over larger areas.
- Predatory dragonfly (or belostomatid) prey choice study. This will involve presenting a series of prey to a predator in aquaria in the lab and evaluating the selectivity of the predator.
- Diel patterns in macroinvertebrate drift in a stream. Drifting is a common method of dispersal and escape for aquatic insects in stream systems. Using drift nets this project will examine whether there are daily patterns in aquatic insect drift in a local stream.
- Examination of diet shifts over a developmental (ontogenetic) gradient in an invertebrate species (e.g., Mysis, Chironomus). This will involve collecting a variety of instar sizes in one species and then examining gut contents. A hypothesis is that diet will shift as the invertebrates change instar.
- Does the River Continuum Concept work to predict macroinvertebrate abundance? This study will collect aquatic invertebrate samples at different downstream locations and examine whether the community changes as the sites move down-stream.
- Examination of biodiversity patterns (in the aquatic invertebrates) across three levels of disturbance.
- Are aquatic invertebrates more or less active at night? Are there trends among different taxa? This study will compare activity among taxa of aquatic invertebrates before and after dark using light traps.
- Do aquatic insect shredders have a ‘taste’ preference or aversion to certain species of leaf? Is all leaf litter equally wanted by aquatic insects? Using some simple techniques this study will examine leaf litter decomposition in a stream setting.
- Do oligochaetes prefer particular substrates? Worm decision making: where to live.
- What are oligochaete defecation rates and how do they affect substrate accumulations.
- Can we use aquatic invertebrate communities as indicators of human disturbance? Using straight-forward field work, this study will examine the impact of human-caused changes on aquatic insect communities.
- How quickly do aquatic invertebrates colonize new habitat and do all taxa contribute equally? Using artificial substrate this study will examine colonization of habitat over time to see if a more diverse assemblage develops.
- In-lake and in-stream field bioassays

**Supplemental library texts to complement research articles:**

**POLICY**

**COMPLAINT PROCEDURE**
Students may direct complaints to the head of the academic unit or department in which the complaint occurs. If the complaint allegedly violates a specific university policy, it may be directed to the head of the department or academic unit in which the complaint occurred or to the appropriate university office responsible for enforcing the policy.

**GRADE APPEALS PROCEDURE**
A student may appeal a grade on the grounds that it is based on a capricious or arbitrary decision of the course instructor. Such an appeal shall follow the established procedures adopted by the department, college, or school in which the course resides. These procedures are available in writing from the respective department chairperson or the Academic Dean of the College/School.
A more detailed description of the grade Appeal Policy may be found in UWM Selected Academic and Administrative Policies, Policy #S-28 and UWM Faculty Document #1243.

**ATTENDANCE**
You are expected to attend class. While you are not graded based on attendance, there is a strong correlation of attendance with your final grade. You should contact me or the WATER Institute (414-382-1700) if you are unable to attend class.

**LEARNING IMPAIRMENTS**
Students with learning impairments should let me know immediately. The University of Wisconsin does not tolerate discrimination against those with learning impairments.
DISCRIMINATION
The University of Wisconsin does not tolerate discrimination in any form. If you have been discriminated against, immediately report the incidence to the Departmental Chair or the Dean of the College of Letters and Sciences.

SEXUAL HARASSMENT
Sexual harassment is reprehensible and will not be tolerated by the University. It subverts the mission of the University and threatens the careers, educational experience, and well being of students, faculty, and staff. The University will not tolerate behavior between or among members of the University community which creates an unacceptable working environment.

ACADEMIC MISCONDUCT
The university has a responsibility to promote academic honesty and integrity and to develop procedures to deal effectively with instances of academic dishonesty. Students are responsible for the honest completion and representation of their work, for the appropriate citation of sources, and for respect of others’ academic endeavors. A more detailed description of Student Academic Disciplinary Procedures may be found in Regents Policy Statements, UWS Chapter 14 and UWM Faculty Document #1686.

SAFETY
Should you be injured in any way, report it to me or the TA and the Department of Biological Sciences office. If you have special medical concerns, report them to me immediately, e.g., sensitivity to formalin.

LABORATORY PROTOCOL
Specimens should be returned to their proper location, e.g., slides to the correct slide tray. Please clean your work area at the end of class.

University Policy Link.
General link to the Secretary of the University Web site (http://www.uwm.edu/Dept/SecU/SyllabusLinks.pdf) that contains the following University policies:

1. Students with disabilities. Notice to these students should appear prominently in the syllabus so that special accommodations are provided in a timely manner. http://www.uwm.edu/Dept/DSAD/SAC/SACltr.pdf
2. Religious observances. Accommodations for absences due to religious observance should be noted. http://www.uwm.edu/Dept/SecU/acad%2Badmin_policies/S1.5.htm
3. Students called to active military duty. Accommodations for absences due to call-up of reserves to active military duty should be noted. http://www.uwm.edu/Dept/SecU/acad%2Badmin_policies/S40.htm
4. Incompletes. A notation of “incomplete” may be given in lieu of a final grade to a
student who has carried a subject successfully until the end of a semester but who, because of illness or other unusual and substantiated cause beyond the student's control, has been unable to take or complete the final examination or to complete some limited amount of term work.

http://www.uwm.edu/Dept/SecU/acad%2Badmin_policies/S31.pdf

5. **Discriminatory conduct (such as sexual harassment).** Discriminatory conduct will not be tolerated by the University. It poisons the work and learning environment of the University and threatens the careers, educational experience, and well-being of students, faculty, and staff.

http://www.uwm.edu/Dept/SecU/acad%2Badmin_policies/S47.pdf

6. **Academic misconduct.** Cheating on exams or plagiarism are violations of the academic honor code and carry severe sanctions, including failing a course or even suspension or dismissal from the University.

http://www.uwm.edu/Dept/OSL/DOS/conduct.html

7. **Complaint procedures.** Students may direct complaints to the head of the academic unit or department in which the complaint occurs. If the complaint allegedly violates a specific university policy, it may be directed to the head of the department or academic unit in which the complaint occurred or to the appropriate university office responsible for enforcing the policy.

http://www.uwm.edu/Dept/SecU/acad%2Badmin_policies/S49.7.htm

8. **Grade appeal procedures.** A student may appeal a grade on the grounds that it is based on a capricious or arbitrary decision of the course instructor. Such an appeal shall follow the established procedures adopted by the department, college, or school in which the course resides or in the case of graduate students, the Graduate School. These procedures are available in writing from the respective department chairperson or the Academic Dean of the College/School.

http://www.uwm.edu/Dept/SecU/acad%2Badmin_policies/S28.htm

9. **Other** The final exam requirement, the final exam date requirement, etc.

http://www.uwm.edu/Dept/SecU/acad%2Badmin_policies/S22.htm