Crabtree Creek, Garrett Co.

Syllabus
Spring, 2024 (12/7/2023, subject to change)

"*To a person uninstructed in natural history, his country or sea-side stroll is a walk through a gallery filled with wonderful works of art, nine-tenths of which have their faces turned to the wall. Teach him something of natural history, and you place in his hands a catalogue of those which are worth turning around. Surely our innocent pleasures are not so abundant in this life, that we can afford to despise this or any other source of them.*"
— Thomas Henry Huxley, On the Educational Value of the Natural History Sciences (1854). In Collected Essays (1893). Vol. 3, 63.

"*One of the penalties of an ecological education is that one lives alone in a world of wounds. Much of the damage inflicted on land is quite invisible to laymen. An ecologist must either harden his shell and make believe that the consequences of science are none of his business, or he must be the doctor who sees the marks of death in a community that believes itself well and does not want to be told otherwise.*"
— Aldo Leopold, Sand County Almanac, 1949


Created wetland, Caroline Co.

***Anax junius* (Odonata: Aeshnidae)**
← →

Instructors

Dr. Bill Lamp, Professor
Department of Entomology, 4138 PLS
University of Maryland, College Park
301-405-3959
lamp@umd.edu

TA: Shane Windsor
4178 PLS
443-679-8571
windsor@umd.edu

Overview

"Aquatic Entomology" is designed for graduate students and advanced undergraduates with interests in aquatic ecology and the identification of insects inhabiting lentic (e.g., lakes, ponds, wetlands) and lotic (e.g., rivers, streams, creeks) habitats. Because of the widespread occurrence of aquatic species within the hexapods, insects have invaded freshwater habitats many times during their evolution, in some cases multiple times within an order of insects. This evolution has resulted in a diversity of morphological and physiological adaptations. Thirteen orders of the Class Insecta and other hexapods, including approximately 145 families and 650 genera in North America, have species that are intimately associated with freshwater at least part of their life cycle. Aquatic insects serve critical functions of freshwater ecosystems, including organic material processing, herbivory of micro- and macrophytes, predation of invertebrates (including other insects) and vertebrates (such as amphibians and fish), and as food for higher trophic levels. Because individual taxa respond differently to physical and chemical conditions of freshwater habitats, they are commonly used as bioindicators of environmental stresses caused by humans. In addition, many species of aquatic insects are important pests, such as mosquitoes and black flies. The course will emphasize the biology, ecology, and identification of aquatic insects (and other hexapods), as well as applied aspects of biological monitoring and pest management.

For Spring, 2024, the course has been converted to a blended course with recorded lectures and in-person labs and field trips. The lectures are recorded online through ELMS using Panopto. Readings and other resources are posted on ELMS as well. Topics on the website and in lab are organized by weeks, starting on Wednesdays and ending on Tuesdays during the lab.

Educational Objectives

The course is designed for students to:

1. Develop an understanding of the biology and ecology of insects found in freshwater,
2. Develop skills and knowledge required to collect and identify families and genera of aquatic insects,
3. Become familiar with the diversity, function, and adaptation of insects in freshwater habitats,
4. Examine applied aspects of aquatic entomology, and
5. Become familiar with current research relating to aquatic entomology.

Scheduled Time and Place for the Lab/Field Trips

The Teaching Lab, PLS 1161, is 11:00-1:50 on Tuesdays for the in-person labs. Field trips are scheduled based on weather and water conditions, so consider the listing of field trip on the schedule as "if weather permits." If we leave on long field trips at 11:00, we can expect to return between 5:00-6:00. An overnight camping field trip is planned for the last weekend of the semester (May 4-5) to Garrett County, MD.

Middle Patuxent River, Howard Co.

Credit

Three credits.

Frequency of Offering

Spring semesters of even years.

Prerequisite

Permission of instructor.

Relationship to Other Courses

No other course on aquatic entomology is offered on campus. Among entomology courses, BSCI 481, "Insect Diversity and Classification," includes orders of aquatic insects, however identification is not beyond the family level. BSCI 467, "Freshwater Biology," considers only family-level identification for insects living in aquatic habitats, and identification is limited to a few sampled habitats. Aquatic Entomology expands the context to include families and genera throughout Maryland. Furthermore, the course will address the biology of the adult stages of aquatic insects. Although most aquatic insects are intimately associated with water only in larval stages, the biology of the adult stages are important in understanding these species.

Course Description for Schedule of Classes

ENTM 667 Aquatic Entomology (3) One hour of lecture and six hours of laboratory per week. Biology, ecology, and taxonomy of aquatic insects in lotic and lentic habitats, their adaptation to aquatic life, their function in aquatic ecosystems, and their relationship to environmental deterioration.

The Course's Targeted Audience

The course is being offered as a course for graduate students in entomology, environmental science and technology, conservation biology, and MEES. The maximum enrollment is 10. Advanced undergraduates with background in entomology are welcome.



Required Text

The text is: Merritt, R.W., K.W. Cummins, and M.B. Berg (eds.). 2008. An Introduction to the Aquatic Insects of North America, 4th ed. Kendall/Hunt Publ. Co. This edited book provides up-to-date keys to genera of North American aquatic insects, as well as general introductions to major topics such as feeding groups, respiration, and biology of all aquatic insect orders. Recent revisions and corrections, bibliographies for each order, and other useful sources of information will be provided. Several copies of the book are available in the Teaching Lab for student use.

Website

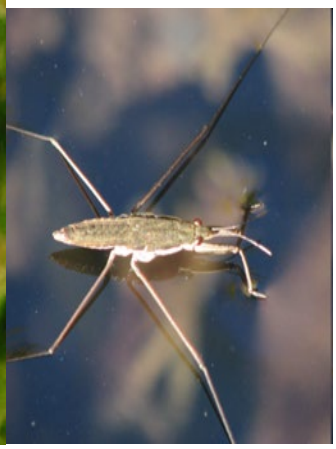
The course website is accessed through https://elms.umd.edu
The site includes the syllabus, course schedule, handouts, lecture materials, handouts, and other information. There are modules for each of the first two weeks, and then a module for each order (plus one for all minor orders). There is a module labelled "Reference Material" that includes information that you may want to download for current or future use, e.g.:

1. Two introductory chapters from McCafferty's book on "Aquatic Entomology", providing background information and morphology.
2. The entire "Aquatic Insects of North and South Carolina", which is out of print, and is considered the only comprehensive key to species of aquatic insects in our region.
3. An article by MacAdam and Stockan (2015) on the ecosystem services provided by aquatic insects.
4. The US EPA document on Rapid Bioassessment Protocols.
5. Special publication from Hydrobiologia on 'Freshwater Animal Diversity Assessment" (2008), 274 pages.

Overview of Laboratory

Dr. Becca Wilson-Oenekeo, Casselman River, Garrett Co.

The laboratory period is a mixture on in-person and online, and is devoted to learning the identification of aquatic insects, collecting specimens during field trips, and organizing the specimens into a collection. During the first two weeks, students will be exposed to order-level identification and start a collection using samples brought to the lab. During subsequent weeks, students will identify families and genera of collected specimens within individual orders. In addition, a teaching collection will be used to expose students to common families and genera not collected by the class. When conditions are suitable, we will go on field trips to visit and collect at aquatic habitats from the Eastern Shore to the Maryland mountains. The course will conclude with an overnight camping trip to Big Run State Park in Garrett County to collect from some of the cleanest waters in Maryland.



Grading

Fishing Creek, Frederick Co.

The performance of students in the class will be based on three activities:

1. Collection. Each student will develop a collection of aquatic invertebrates based primarily on field trips. Details on the targeted number of families and genera will be provided.
2. Each student will maintain a notebook of their collection. Students may work in the lab alone or in pairs. Either way, each student should maintain a lab notebook, preferably as a Google Doc but hardcopy is okay. The notes should include any collection information (where, when, who, how) as well as photos of the site. For in-class collections (where the instructor will bring samples from the field to the lab), this information will be provided to you. For each collection site, notes should include both the identifications that you make as well as those from others as posted on the board. Your notebook, virtual or hardcopy, should be turned in at the end of the semester.
3. Article reviews. During four weeks of the semester, I will assign a paper to read dealing with the ecology of aquatic insects. Each student should provide no more than a 1-2 page review of each article. The review should consist of the citation of the article, your name and date, and two paragraphs of text. The first paragraph should be a concisely worded statement of the context of the research, the objective/hypothesis to be tested, a brief statement of the approach, and the general findings, including a clear statement of the most significant finding. The second paragraph is your critical review, such as:
    a. Is the research of significance?
    b. Did the methods actually test the hypothesis?
    c. Was the analysis correct?
    d. Does the data actually support their conclusions?
    e. How could they have improved the study?

List of articles (may be replaced by the start of the semester):

Article 1: Nakano, S., H. Miyasaka, and N. Kuhara. 1999. Terrestrial-aquatic linkages: Riparian arthropod inputs alter trophic cascades in a stream food web. Ecology 80: 2435-2441.
Article 2: Culler, L.E., M.P. Ayres, and R.A. Virginia. 2015. In a warmer Arctic, mosquitoes avoid increased mortality from predators by growing faster. Proceedings Royal Society B 282: 20151549.
Article 3: Cheney, K.N., A.H. Roy, R.F. Smith, and R.E DeWalt. 2019. Effects of stream temperature and substrate type on emergence patterns of Plecoptera and Trichoptera from Northeastern United States headwater streams. Environmental Entomology 48: 1349-1359.
Article 4: Lund, J.O., S.A. Wissinger, and B.L Peckarsky. 2016. Caddisfly behavioral responses to drying cues in temporary ponds: implications for effects of climate change. Journal of Freshwater Science 35: 619-630.

General Reference Books[1]

Allan, J.D. 1995. *Stream Ecology*. Chapman & Hall, New York.

Allan, J.D., and M.M. Castillo. 2007. *Stream Ecology: Structure and Function of Running Waters* (2nd ed.). Netherlands: Springer.

Batzer, D.P., and R.R. Sharitz (eds). 2006. *Ecology of Freshwater and Estuarine Wetlands.* University of California Press, Berkeley, CA.

Borror, D.J., C.A. Triplehorn, and N.F. Johnson. 1989. *An Introduction to the Study of Insects* (6th ed.). Harcourt Brace College Publishers, New York.

Bronmark, C., and L.A. Hansson. 1998. *The Biology of Lakes and Ponds: Biology of Habitats.* Oxford University Press Inc., New York.

Brigham, A.R., W.U. Brigham, and A. Gnilka (eds). 1982. *Aquatic Insects and Oligochaetes of North and South Carolina*. Midwest Aquatic Enterprises, Mahomet, Illinois.

Closs, G., B. Downes, and A. Boulton. 2004. *Freshwater Ecology*. Blackwell Scientific Publ., UK.

Colburn, E.A. 2004. *Vernal Pools: Natural History and Conservation.* McDonald & Woodward Publishing Company, Blacksburg, VA.

Cole, G.A. 1994. *Textbook of Limnology*, 4th ed. Waveland Press, Prospect Heights, Illinois.

Dodds, W.K., and M.R. Whiles. 2010. *Freshwater Ecology: Concepts and Environmental Applications of Limnology* (2nd ed.). New York, NY: Academic Press.

Downes, B.J., L.A. Barmuta, P.G. Fairweather, D.P. Faith, M.J. Keough, P.S. Lake, B.D. Mapstone, and G.P. Quinn. 2002. *Monitoring Ecological Impacts: Concepts and Practice in Flowing Waters.* Cambridge University Press, UK.

Giller, P.S., and B. Malmqvist. 1998. *The Biology of Streams and Rivers: Biology of Habitats.* Oxford University Press Inc., New York.

Gordon, N.D., T.A. McMahon, B.L. Finlayson, C.J. Gippel, and R.J. Nathan. 2004. *Stream Hydrology: An Introduction for Ecologists.* John Wiley & Sons, Ltd., Chippenham, Wiltshire, Great Britain.

Hauer, F.R., and G.A. Lamberti (eds.). 2006. *Methods in Stream Ecology*, 2nd edition. Elsevier, New York.

Holland, M.M., E.R. Blood, and L.R. Shaffer (eds.). 2003. *Achieving Sustainable Freshwater Systems: A Web of Connections.* Island Press, Washington, D.C.

Hooks, D.D. (ed.). 1988. *The Ecology and Management of Wetlands: Ecology of Wetlands* (Vol. 1). Timber Press, Portland, OR.

Hynes, H.B.N. 1970. *The Ecology of Running Waters*. University of Toronto Press.

[1]References that focus on specific orders of aquatic insects will be provided in class.

Keddy, P.A. 2000. *Wetland Ecology Principles and Conservation: Cambridge Studies in Ecology.* Cambridge University Press, New York.
Lancaster, J., and B.J. Downes. 2013. *Aquatic Entomology*. Oxford Press, UK.
Leopold, L.B. 1994. *A View of the River.* Harvard University Press, Cambridge, MA.
Leopold, L.B. 1997. *Water, Rivers and Creeks*. University Science Books, Sausalito, California.
Mackie, G. 2004. *Applied Aquatic Ecosystem Concepts* (2nd ed.). Kendall/Hunt Publishing Company, Dubuque, IA.
Maitland, P.S. 1990. *Biology of Fresh Waters*, 2nd edition. Chapman and Hall, New York.
McCafferty, W.P. 1983. *Aquatic Entomology*. Jones and Bartlett Pubs., Sudbury, Massachusetts.
Peckarsky, B.L., P.R. Fraissinet, M.A. Penton, and D.J. Conklin, Jr. 1990. *Freshwater Macroinvertebrates of Northeastern North America*. Cornell University Press, Ithaca, New York.
Pielou, E.C. 1998. *Fresh Water*. University of Chicago Press, Chicago.
Rosenberg, D.M., and V.H. Resh. 1993. *Freshwater Biomonitoring and Benthic Macroinvertebrates*. Chapman and Hall, New York.
Rydin, H., and J. Jeglum. 2006. *The Biology of Peatlands: Biology of Habitats.* Oxford University Press Inc., New York.
Schueler, T.R., abd H.K. Holland. 2000. *The Practice of Watershed Protection: Teaching for Protecting our Nation's Streams, Lakes, Rivers and Estuaries.* Center for Watershed Protection, Ellicott City, MD.
Silk, N., and K. Ciruna (eds.). 2004. *A Practitioner's Guide to Freshwater Biodiversity Conservation.* Washington, DC: Island Press, Washington, D.C.
Thorp, J.H., and A.P. Covich (eds.). 1991. *Ecology and Classification of North American Freshwater Invertebrates*. Academic Press, New York.
Thorp, J.H., and D.C. Rogers. 2011. *Field Guide to Freshwater Invertebrates of North America*. Academic Press, New York.
Usinger, R.L. (ed.). 1971. *Aquatic Insects of California*. University of California Press, Berkeley.
Van der Valk, A.G. 2006. *The Biology of Freshwater Wetlands: Biology of Habitats*. New York, NY: Oxford University Press Inc.
Vogel, S. 1981. *Life in Moving Fluids: The Physical Biology of Flow.* Princeton University Press, Princeton, NJ.
Vogel, S. 1988. *Life's Devices: The Physical World of Animals and Plants.* Princeton University Press, Princeton, NJ.
Voshell, J.R., Jr. 2002. *A Guide to Common Freshwater Invertebrates of North America.* McDonald & Woodward Publishing Company, Granville, OH.
Ward, J.V. 1992. *Aquatic Insect Ecology. 1. Biology and Habitat*. John Wiley, New York.
Wetzel, R.G. 2001. *Limnology: Lake and River Ecosystems* (3rd ed.). San Diego, CA: Academic Press.
Wichard, W., W. Arens, and G. Eisenbeis. 2002. *Biological Atlas of Aquatic Insects*. Apollo Books, Stenstrup, Denmark.
Williams, D.D., and B.W. Feltmate. 1992. *Aquatic Insects*. CAB International, Wallingford, United Kingdom.
Williams, D.D. 2006. *The Biology of Temporary Waters.* Oxford University Press Inc., New York.