

**BSCI 467: FRESHWATER BIOLOGY**  
**Fall, 2022**

August 15, 2022 (subject to change)

*"To a person uninstructed in natural history, his country or seaside stroll is a walk through a gallery filled with wonderful works of art, nine-tenths of which have their faces turned to the wall."*  
 - Thomas Henry Huxley



*"Here is the means to end the great extinction spasm. The next century will, I believe, be the era of restoration in ecology."*  
 - E.O. Wilson, "The Diversity of Life" (1992)

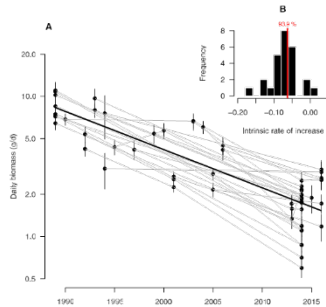


Fig 4. Temporal distribution of insect biomass at selected locations. (A) Daily biomass (mean  $\pm$  1 se) across 25 locations sampled in multiple years (see Fig. 2 for seasonal distributions). (B) Distribution of mean annual rates of decline as estimated based on plot-specific logistic models (annual trend coefficient = -0.103,  $se = 0.002$ , i.e. 5.2% annual decline).



*"There are three principal means of acquiring knowledge... observation of nature, reflection, and experimentation. Observation collects facts; reflection combines them; experimentation verifies the result of that combination."*  
 - Denis Diderot (1713-1784)



### **Course Description**

“Freshwater Biology” is designed for upper-level undergraduates with interests in aquatic ecology and the biology of organisms inhabiting lentic (e.g., lakes, ponds, wetlands) and lotic (e.g., rivers, streams, creeks) habitats. One feature of the course is the hands-on experience through field trips during the first third of the course. This experience will provide background and reinforcement of principles and facts from lectures and discussions on the ecology of freshwater organisms, population and community ecology, and the ecosystem structure and function of freshwaters. The identification portion of the laboratory during the last two-thirds of the course will emphasize aquatic insects, which are often the most diverse and abundant group of organisms associated with freshwater habitats. Other components of freshwater ecosystems, e.g. plankton and periphyton as primary producers, and fish as higher level consumers, will be included in discussions. A second feature of the course is the use of primary research articles and invited scientists to introduce key ecological concepts and to generate discussion on the process and growth of knowledge within freshwater ecology.

The biology of freshwaters is set in the context of the human landscape: our freshwater needs, our use for disposing wastes, and our transformation of our environment, especially as it disrupts the hydrologic cycle. All of these activities impact the quantity and quality of water resources for humans as well as the organisms that live in the water. The theme of sustainability of water resources for future generations underlies many of the topics of freshwater biology.

Topics covered in Freshwater Biology are listed as “Key Questions” on the class ELMS webpage. See “Modules”, then “General Information” for the document.



### **Covid pandemic during the fall 2022 semester**

Our course must follow rules provided by the State of Maryland, Prince George’s County, and the University of Maryland. These are provided here: <https://umd.edu/4maryland> Students are expected to be vaccinated; if you are not, you will need to follow alternative procedures for both lectures and labs. Students are recommended to wear KN-95 masks while indoors, but it is not a requirement. If you experience Covid symptoms, PLEASE stay home and contact me as soon as possible. Get tested and follow University procedures before coming back to campus.



**Instructor** (Office hours by appointment, either live in his office or by Zoom)  
Dr. Bill Lamp, Professor, Department of Entomology, [lamp@umd.edu](mailto:lamp@umd.edu)

**Teaching Assistants** (Office hours by appointment)

Wednesday Section: Amanda Brucchieri, Graduate Student, [abrucchi@umd.edu](mailto:abrucchi@umd.edu)

Thursday Section: Ali Shokoohi, Graduate Student, [shokoohi@umd.edu](mailto:shokoohi@umd.edu)

### Learning Outcomes

After successfully completing this course you will be able to:

1. Develop an understanding of freshwater ecosystems, as well as the biology and ecology of organisms found in freshwater,
2. Apply skills and knowledge required to collect and identify common macroinvertebrate freshwater taxa, based on morphological keys and the use of DNA barcoding,
3. Describe the diversity, function, and adaptation of macroinvertebrates in freshwater habitats,
4. Apply the concept of sustainability to the use of freshwaters for humans, and explain monitoring techniques and ecological responses of freshwater organisms in association with water quality deterioration,
5. Be able to critically read, with an understanding of salient points, original research articles relating to freshwater ecology, and
6. Understand how to communicate of science to the public using examples from freshwater biology.

### Credit and location

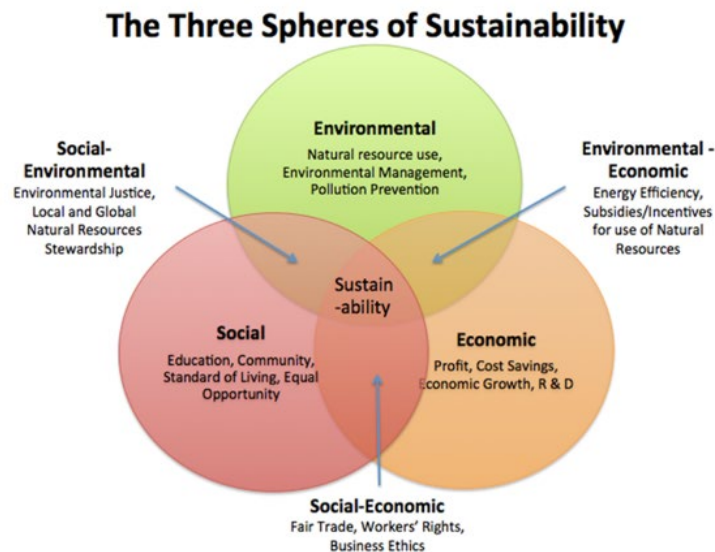
Four credits: lectures at 1:00-1:50 on Monday, Wednesday, and Friday in Room 1100, Cambridge Community Center, and laboratories at 2:00-5:00 on Wednesday or Thursday in Room 1161, Plant Sciences Bldg.

### Frequency of Offering

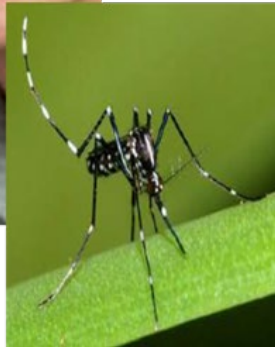
Each fall.

### Prerequisite

BSCI 106/160.



## Guest speakers



**Dr. Paul Leishman, Environmental Science and Technology**

**Dr. Jen Shaffer, Anthropology**



**Dr. Margaret Palmer, Entomology and SESYNC (Socio-Economic Synthesis Center)**



**Dr. Brett Kent, Entomology**

## Course Description for Schedule of Classes

BSCI 467 Freshwater Biology (4). Three hours of lectures and three hours of laboratory per week. Biology and ecology of freshwater invertebrates in lotic and lentic habitats, their adaptation to aquatic life, their function in aquatic ecosystems, and their relationship to environmental deterioration. Laboratory will include field trips, demonstrations, and identifications.

## The Course's Targeted Audience

The course is being offered as an upper level lab course for undergraduate students in biology and environmental science. The maximum enrollment is 48 (24 for each lab section).

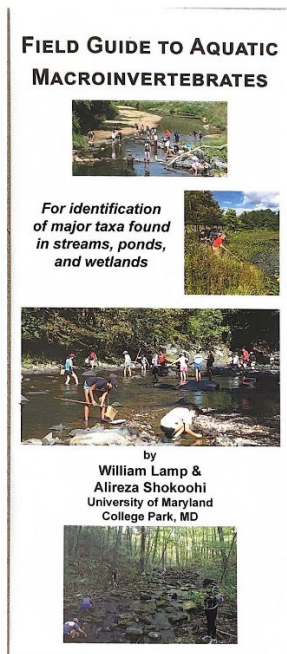
## Website

The course website is accessed through <https://elms.umd.edu>. The site includes the syllabus, course schedule, handouts, lecture materials, assignments, pictures from field trips, old exams, and other information. Use the “Modules” tab to find lecture notes, resources, assignments, field trip and lab information, etc.

## Texts

The “Field Guide to Aquatic Macroinvertebrates” will be provided during the first lab and will be useful to identify the higher taxa of what we collect. The “Freshwater Biology Lab Manual” will be provided in late September and will be helpful for identifications in the lab. If interested, there is a list of books on topics within freshwater biology posted.

No other text is required. Articles will be made available to you as PDF files for reading assignments, Part II.



## FRESHWATER BIOLOGY LAB MANUAL

PREPARED BY WILLIAM LAMP, ALIREZA SHOKOOHI, AND MARGARET HARTMAN

2021



A guide to invertebrate life under  
and on the water's surface

## Grading

| Source                                        | Points     | Percentage    |
|-----------------------------------------------|------------|---------------|
| <b>Exams and Participation</b>                |            |               |
| Midterm                                       | 100        | 13.33         |
| Final                                         | 100        | 13.33         |
| Participation (given at end, lab and lecture) | 50         | 6.67          |
| <i>Subtotal</i>                               | <i>250</i> | <i>33.33</i>  |
| <b>Lecture</b>                                |            |               |
| POGIL group discussions (5@10 pts)            | 50         | 6.67          |
| Assignments, Part I (5@10 pts)                | 50         | 6.67          |
| Assignments, Part II (5@10 pts)               | 50         | 6.67          |
| Sustainability exercise, Part I               | 25         | 3.33          |
| Barcoding analysis, Part II                   | 25         | 3.33          |
| <i>Subtotal</i>                               | <i>200</i> | <i>26.67</i>  |
| <b>Lab</b>                                    |            |               |
| Order practical                               | 50         | 6.67          |
| Midterm practical                             | 50         | 6.67          |
| Final practical                               | 50         | 6.67          |
| Exercises (2@10 pts)                          | 20         | 2.67          |
| Collection                                    | 100        | 13.33         |
| Barcoding discussion and notes                | 30         | 4.00          |
| <i>Subtotal</i>                               | <i>300</i> | <i>40.00</i>  |
| <b>TOTAL</b>                                  | <b>750</b> | <b>100.00</b> |

The grading scale is:

97-100%, A+

91-96.9%, A

90-90.9%, A-

<60%, F

88-89.9%, B+

81-87.9%, B

80-80.9%, B-

78-79.9%, C+

71-77.9%, C

70-70.9%, C-

68-69.9% D+

61-67.9% D

60-60.9%, D-

### POGIL Discussions

POGIL (process-oriented guided-inquiry learning) is a structured method of increasing student involvement in class and engaging students in learning. The class will be assigned into groups of 3 or 4 students, with each student performing a specific role: manager, presenter, recorder, and reflector. These roles will be explained in class. During the period, each group will be given a model and set of questions, work collaboratively on the answers, and prepare written answers. Discussion across groups will also occur to help with clarification of the topic. There is no work done on the topic beforehand, and answers are due by the end of class. If a student misses class that day, then he/she must review the model and questions (which will be posted on ELMS after class), and submit the answers by the next class period. Grades will be given equally within each group based on the written answers, and will be evaluated for both content and readability.





## **DNA barcoding**

We are able to provide a special experience to Freshwater Biology students this fall!: Each student will use DNA barcoding to identify a collected insect specimen of their choice. You will each collect and photograph an insect from one of our field trips, preserve it in alcohol, extract its DNA, use PCR to amplify the targeted gene region (i.e., DNA barcode), and use the DNA barcode sequence to identify the specimen by using BLAST in NCBI GenBank. A lecture by Dr. Alina Avanesyan on Friday, September 16, will provide background to DNA barcoding and introduction to the steps described on a special ELMS page. You will be invited to join the page in the first weeks of the course.

You will be graded on the exercise in two ways. First, you will maintain a notebook to record notes of your barcoding activities starting with the collection of your chosen specimen and ending with the results of blasting. Second, you will prepare a lab report providing the details of the barcoding as well as a description of the biology and ecology of your species. In addition, you will report your findings to the class during the final week of classes.

## **Attendance in Lecture and Lab**

Attendance for all lectures and laboratories is required. Each unexcused absence will result in an automatic 5% reduction in your total score. It is your responsibility to contact Dr. Lamp and your TA, either Ali or Maggie, in a timely way for any absence:

- If you expect to miss class because of a religious holiday, a special travel event, or other reason, send Dr. Lamp an email ([lamp@umd.edu](mailto:lamp@umd.edu)) beforehand providing the reason, the dates you will be absent, and include the statement, "I acknowledge that the information in this note is accurate." You are required to make up any information that you miss. Every effort should be made to turn in due assignments before you miss class, or to make up the lab by attending the other section. If you will miss the lab, contact both Dr. Lamp and the TA.
- If you missed class because of a medical issue or some unforeseen event, send Dr. Lamp an email ([lamp@umd.edu](mailto:lamp@umd.edu)) as soon as possible providing the reason, the dates you were absent, and include the statement, "I acknowledge that the information in this note is accurate." If you missed the lab, contact both Dr. Lamp and the TA. You are required to make up any information that you miss. You should turn in due assignments at the next class period.
- Check with Dr. Lamp and/or the TA for specific information and activities you may miss.

I reserve the right to verify any absence through the contact of your family, medical provider, etc. Additional information on the University of Maryland policy on medically-necessitated absence from class as well as a wide range of course-related policies can be found at:

<http://www.ugst.umd.edu/courserelatedpolicies.html>

## Code of Academic Integrity

The University of Maryland, College Park has a nationally Recognized Code of Academic Integrity, administered by the Student Honor Council. This Code sets standards for academic integrity at Maryland for all undergraduate and graduate students. As a student you are responsible for upholding these standards for this course. It is very important for you to be aware of the consequences of cheating, fabrication, facilitation, and plagiarism. For more information on the Code of Academic Integrity, please visit the website cited above.



## Overview of Laboratory

The laboratory period will be divided into two general parts: field trips during the first third of the semester, and labs for identification of macroinvertebrates during the last two-thirds of the semester. The skills and knowledge gained during the identification labs will be applied to the organisms observed and collected during the field trips. Students are paired to help each other with both field collection and lab identification. Video descriptions of field trips are available under “General Resources” within the “Modules” tab.

The first lab (Wk01) is designed to help you learn the higher taxonomy of macroinvertebrates using the Field Guide. You are expected to learn the orders of macroinvertebrates by sight by the first field trip (Wk02). During the field trips, you will make a collection from several sites. You will preserve the macroinvertebrates in ethyl alcohol, and then separate the higher taxa into separate vials. Each vial should be labeled clearly with location (state, county, specific site), date, and collector (labels will be provided). These specimens will help you to learn the family level taxonomy in subsequent weeks. The collection will be graded. Details will be provided by the TA.

For the identification lab sessions, an overview of the biology and classification of the taxa will be provided by the TA. You will use your own and reference specimens to learn identification using the Lab Manual and noting primary characteristics. We encourage you to use your Lab Manual during practicals for identification. We also encourage you to take notes in the Manual during the “Taxon” lectures that may also be useful in identifications.





**Boots and Safety for Field Trips**

IF YOU HAVE BARE FEET, OR ONLY WEAR FLIP-FLOPS, YOU WILL NOT BE ALLOWED TO ENTER THE WATER. Some students desire to wear hip boots or waders when collecting specimens in streams and ponds during field trips. Hip boots may be purchased on line or locally at Walmart, Dick’s, Bass Pro Shop, and other sporting goods stores. Old tennis shoes, Keene’s, or other water shoes are acceptable. During the first lab, we will discuss the need for boots and options for purchase.





The field trip sites are generally safe places to collect invertebrates. The TAs will inform you about safety; e.g., some locations can be especially slippery. Also, it is not safe to expose open wounds to freshwaters. If you have an open cut, you should not get into the water. If you are cut during a field trip, inform the TA immediately for care. The TA will have a first aid kit available in case of minor injuries.



### Lab Practicals

The lab practicals will test your knowledge of collected organisms. You will be expected to know all aquatic subclasses/orders of macroinvertebrates by sight, and selected families by using the key (Lab Manual). Questions will also cover key morphological features used in identification and major biological characteristics of the taxa. The first practical (covering orders) will occur during the field trip to Fishing Creek – you will not be allowed to have any notes or guides to use during the first practical. See the schedule for dates.





# BSCI 467 Schedule, Fall-2022

August 15, 2022 (subject to change)

| Week                  | Topic                                         | Lecture                                                                                                                                      | Laboratory                                                                | Assignments <sup>1</sup>                                                               |
|-----------------------|-----------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------|----------------------------------------------------------------------------------------|
| 1<br>Aug 29-<br>Sep 2 | <b>Life in freshwater</b>                     | M: Objectives and procedures<br>W: Life in freshwater<br>F: POGIL: Consequences of water                                                     | Lab: Orders of macroinvertebrates                                         |                                                                                        |
| 2<br>Sep 7-9          | <b>Water, water, everywhere?</b>              | M: Labor Day!<br>W: Taxonomy revisited and field trips<br>F: Our water, our life                                                             | Field: Sampling of campus aquatic habitats                                | 1. "Getting to Know Paint Branch"                                                      |
| 3<br>Sep 12-16        | <b>Hydrology as a template for ecosystems</b> | M: Water properties<br>W: Life history of water<br>F: Dr. Alina Avanesyan, "DNA Barcoding: Value and Process"                                | Field: Middle Patuxent River (To 6:00)                                    | 2. "Drainage Basins and Hydrology"                                                     |
| 4<br>Sep 19-23        | <b>Ecosystems still</b>                       | M: Freshwater ecosystems: Structure and function<br>W: Lentic waters as habitats<br>F: cont.                                                 | Field: Lake Artemesia (To 5:00)                                           | 3. "American Rivers Quiz"                                                              |
| 5<br>Sep 26-30        | <b>Ecosystems flowing</b>                     | M: Lotic waters as habitats<br>W: POGIL: Hydrographs and urbanization<br>F: TED talks on freshwater                                          | Field: Fishing Creek, Catoctin Mts, including "field practical" (To 7:00) | 4. "Notes from TED talks on freshwater"                                                |
| 6<br>Oct 3-7          | <b>Species adapt to habitats</b>              | M: Food resources and trophic interactions<br>W: POGIL: Freshwater ecosystems through time<br>F: Aquatic insects: Respiration/osmoregulation | Non-Insecta Insect morphology assignment                                  | View Panopto recording for the Sustainability Exercise and group assignments by Oct 11 |
| 7<br>Oct 10-14        | <b>For a sustainable future ...</b>           | M: Sustainability group discussion<br>W: Group presentations<br>F: Group presentations                                                       | Ephemeroptera                                                             | 5. "Blog: Observations of Fishing Creek"                                               |
| 8<br>Oct 17-21        | <b>Mid-semester transition</b>                | M: Midterm review<br>W: Midterm exam<br>F: POGIL: Science and experimentation                                                                | Plecoptera Insect mouthpart exercise                                      |                                                                                        |





| Week              | Topic         | Lecture                                                                                                                                                                                   | Laboratory                                | Assignments <sup>1</sup>                                                     |
|-------------------|---------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------|------------------------------------------------------------------------------|
| 9                 | Oct 24-28     | <b>Science is a verb</b><br>M: Science and ecology/hypothesis development discussion<br>W: Science writing<br>F: Discussion of midterm exam                                               | Odonata, Hemiptera                        | 6. Moore & Williams (1990)                                                   |
| 10                | Oct 31- Nov 4 | <b>Unintended and restored interactions</b><br>M: Pollution and water quality<br>W: POGIL: Macroinvertebrates and water quality<br>F: TBD                                                 | Lab practical DNA extraction and PCR prep | 7. Death & Zimmerman (2005)                                                  |
| 11                | Nov 7-11      | <b>Disturbance is not so bad</b><br>M: Dr. Paul Leisnham: "Disease ecology theory and practice"<br>W: Balance of nature?<br>F: TBD                                                        | Megaloptera, Lepidoptera Trichoptera      | 8. Chambers et al. (2005)                                                    |
| 12                | Nov 14-18     | <b>Ecosystem boundaries</b><br>M: Ecosystem linkages and metacommunities<br>W: Unintended effects of new technology: Risk assessment of Bt debris in streams<br>F: Nakano video           | Coleoptera                                | 9. Nakano et al. (1999)                                                      |
| 13                | Nov 21        | <b>Underwater perception</b><br>M: Dr. Brett Kent: "Fly-Fishing and Trout Behavior"<br>W, F: No class                                                                                     | Happy Thanksgiving!                       |                                                                              |
| 14                | Nov 28- Dec 2 | <b>To conserve or to restore</b><br>M: Biodiversity: To conserve or to restore<br>W: Dr. Jen Shaffer: "Water Resources and Human Culture"<br>F: Dr. Margaret Palmer: "Stream Restoration" | Diptera                                   | 10. Palmer et al. (2014)<br>DNA Barcoding Analysis and Discussion due Dec. 2 |
| 15                | Dec 5-9       | <b>Future of freshwaters and their inhabitants</b><br>M: Sustainability revisited<br>W: Barcoding presentations<br>F: Course evaluation                                                   | Final lab practical                       |                                                                              |
| 16                | Dec 12        | <b>Last day of classes</b><br>M: Conclusions                                                                                                                                              |                                           |                                                                              |
| <b>Final Exam</b> |               | Thursday, December 15, 1:30-3:30, in CCC 1100                                                                                                                                             |                                           |                                                                              |

<sup>1</sup> Assignments are due by the end of the day on Monday following the week noted in the schedule.

