WATS/BIO 5550 **Freshwater Invertebrates** **SPRING 2017**

Lectures and labs: Tuesdays and Thursdays: 1:30 – 4:20 pm; BNR 004
Credits: 3 credits
Prerequisites: One year of general biology or zoology
Instructors: **Charles Hawkins**: BNR 162D. chuck.hawkins@usu.edu. 797.2280.
Office hours: by appointment
Joe Kotynek: BNR 160. joe.kotynek@usu.edu. Phone: 797.3945.
Office hours: Monday – Friday 8:30 – 10 am or by appointment

Course Fee

The course fee is $55.00. The fee covers field trip costs (Motor Pool vans) plus collecting supplies (vials, preservative, label paper, and forceps)

Course Goals and Objectives

This course is designed to provide a thorough understanding of freshwater invertebrate taxonomy, ecology, and biology. This course is relevant to those interested in ecology and evolution, fisheries biology, natural resources science and management, environmental assessment and monitoring, or fly fishing.

Specific learning objects include:

1) Understand the evolutionary origins and phylogenetic relationships of freshwater invertebrate groups, basic theory and practice of taxonomy and systematics, adaptations and habitat requirements of freshwater invertebrates, the functional role of invertebrates in freshwater ecosystems, the factors that influence their abundance and distribution across different spatial scales, the use of freshwater invertebrates in environmental assessment, and conservation and restoration science as applied to freshwater invertebrates.
2) Learn how to:
   a. use taxonomic keys to identify freshwater invertebrates and properly curate specimens,
   b. sample streams, lakes, and wetlands for freshwater invertebrates, and
   c. process invertebrate samples to known data quality standards.
3) Practice conducting, interpreting, and reporting project results.

Texts and Reading

There is no required text for this class, but both mandatory and optional reading materials will be provided prior to each class period. You are required to complete readings *before* the assigned class period, as this will greatly enhance your comprehension of lecture materials. Resources include:

Allan, J.D. and M.M. Castillo. 2007. Stream Ecology: Structure and Function of Running Waters. Kluwer Academic, Dordrecht, Netherlands.[1]

Hauer R.F. & G.A. Lamberti. 2007. Methods in Stream Ecology (2nd edition). Academic Press.[1]

Merritt, R.W., K.W. Cummins, and M. B. Berg. 2008. An Introduction to the Aquatic Insects of North America (4th edition). Kendall/Hunt Dubuque, Iowa.[2,3,4]

Resh, V.H. & D.M. Rosenberg. 1984. The Ecology of Aquatic Insects. Praeger, New York.[2,4]

Thorp, J.H. & A.P. Covich. 2010. Ecology and Classification of North American Freshwater Invertebrates (3rd edition). Academic Press, San Diego California.[1]

Ward, J. V. 1992. Aquatic Insect Ecology. John Wiley & Sons, New York.[2,4]

Williams, D.D. & B. W. Feltmate. 1992. Aquatic Insects. CAB International, Wallingford UK.[2,4]

[1]Available online through the USU library course catalog. [2]Copy available on reserve at USU library. [3]Copy available in BNR 160. [4]Scanned material available on Canvas

Canvas

We will use Canvas for sharing announcements, accessing lecture/lab outlines and identification materials, and accessing reading assignments. Your A-number and strong password allows you to access the WATS/BIOL 5550 course site. The course website can be accessed by browsing to https://usu.instructure.com/. Under course list click "Sp17 Biol-5550-001". If you have additional questions or problems, please ask us.

Course Activities and Evaluation

Evaluation of your performance will be based on three metrics: how well you summarize aspects of theory and practice in written assignments, how well you develop skills in identifying freshwater invertebrates, and the quality of the report you produce for the course project. Grades will be based on how many total points, out of a hundred, that you accrue over the term.

Graded item	Points	
Introductory material		10
Three 1-page response papers (5 points each)		15
Identification skills		55
Mid-term lab exam	15	
Final lab exam	15	
Personal collection	25	
Project and report		20
Total possible points		100

Activities and Grading Explained

Introductory material – We will cover several aspects of the evolution, classification, and ecology of freshwater invertebrates during the first 4 weeks of the course. This material will be covered by a combination of lecture, reading, and in-class discussion. You will be evaluated on your command of this material with an in-class, "closed book" exam.

Response papers – You are responsible for reading several assigned papers from the primary literature and writing 1-page response papers for three of these papers (Times Roman, 11-point font, single spaced, 1-inch margins). The objective of this assignment is to provide you with experience interpreting and synthesizing the scientific literature on freshwater invertebrates and to provide practice honing your written communication skills. Assigned papers will relate to topics covered in lecture. I will grade based on both content and clarity of writing. In general, your papers should be organized as follows:

1. Introduce the topic of the paper including the author's objectives/hypotheses and summarize what motivated the authors to conduct the study – i.e., what knowledge gap did the authors want to fill and why was it important to do so.
2. Describe the study design and how it allowed the authors to answer their research question or test their research hypothesis. Summarize the methods they used to collect and analyze data.
3. Summarize the key findings.
4. Comment on the strength of the inferences the authors draw. How convinced were you that their conclusions were sound? What questions remained unanswered, if any, or what new questions emerged? Briefly describe what study you would conduct next that would build on this study if you were part of a research lab: what is the new question/hypothesis and what study type/design would you use.

Identification skills –

Laboratory exams will test your ability to identify the groups of freshwater invertebrates we cover in

class. Exams will focus on taxonomy (short answer questions), morphology (short answer questions), function (short answer), and your ability to identify freshwater invertebrate taxa (combination of sight identifications and use of keys to identify unknowns).

You are required to create and curate a ***personal collection*** of freshwater invertebrate taxa that you catch and identify during the semester. Many of these specimens will be collected during class field trips and will be found during sample processing in the lab. This collection should consist of a minimum of 50 unique taxa, each identified to at least family level, to receive full credit. Genus- and species-level identifications within the same family will count as unique taxa. You may be able to acquire all of the 50 taxa from the collections we make during the four field trips, but we also encourage you to go to the field outside of class time. You can team up with classmates to collect organisms, and you may work together to identify and verify each other's specimens, but each student must turn in their own collection. If several students collect from the same place at the same time, the catch may be divided. Students can check their identified specimens with the Lab Instructor before turning in their collections. Collecting equipment can be checked out from BNR 160. Specimen vials, preservative, and label paper will be provided.

You must also properly curate your specimens. Collections should be preserved in 70% ethyl alcohol and stored in glass vials. Each specimen vial must contain a location label and a taxonomic name label. Location labels should include the waterbody name, county, state, sampling date, and the name of the collector. Taxon labels should include the order, family, and genus/species if identified beyond family level. The life stage should also be noted (larvae, pupa, or adult).

Example taxa label	Example location label
Ephemeroptera	Bear River near Benson
Ephemeridae	Cache County, UT
Hexagenia limbata	23 January 2002
Larvae	CB: J. Kotynek

You should use a laser printer to produce final vial labels. Use waterproof paper and print labels in either 6- or 8-point font. Temporary labels should be written in pencil on waterproof paper. For submission, all vial tops should be consecutively numbered, grouped alphabetically by order or higher taxonomic level when necessary, and accompanied by a typed list of vial contents.

Example of collection's taxa list

Vial #	Taxon
1.	Ephemeroptera, Baetidae, larvae
2.	Plecoptera, Pteronarcyidae, *Pteronarcys californica* larvae
3.	Plecoptera, Pteronarcyidae, *Pteronarcella badia* larvae
4.	Coleoptera, Dytiscidae *Dytiscus* larvae & adult
5.	Coleoptera, Dytiscidae adult
⋮	
49.	Trichoptera, Brachycentridae, *Brachycentrus* larvae
50.	Mesogastropoda, Hydrobiidae, *Potamopyrgus antipodarum* (exotic)

Collections will be graded as follows. Each of the first 50 unique taxa is worth ½ point (total = 25 points). Any additional unique taxa will count as extra credit (also ½ point each) up to 10 additional points.

A **field notebook** must be turned in with your collection. Notebooks can be of any size and be constructed from regular or waterproof paper. I typically use $4^{5/8}$ x 7 inch Rite-in-the-Rain™ notebook. Notebook entries should be legibly written in pencil. Entries should describe where, when, how, and how much sampling was conducted, as well as other observations about the sampling location or sampling conditions that may aid in interpreting the outcome of your sampling such as type of waterbody (e.g., lentic or lotic), water conditions (clarity, drought, flood), substrate type, riparian vegetation, and weather.

Project and report – You will participate in a class project designed to improve your understanding of the

'life history' of a typical invertebrate sample collected in support of environmental or biodiversity assessments. The project will compare the invertebrate assemblages at two locations on the Logan River – a 'reference' site and a degraded site that has been recently 'restored'. You will be responsible for taking quantitative samples at each site, processing the samples in the lab, and using the data to draw inferences regarding differences between the sites. You will be responsible for writing a ~ 10-page (double spaced, 11 point Times Roman font, 1-inch margins) report that describes the project and the conclusions you drew from the data you collected. The report must be written in the standard format of a scientific journal article (Abstract, Introduction, Methods, Results, Discussion, Literature Cited) and must incorporate relevant literature.

Field Experiences

The field experience consists of 4 field trips. All trips will be held during class times, and your active participation is required. We will return to campus by 4:15 on field trip days. The first two trips will focus on collecting quantitative samples in support of the class project. The third and fourth trips will highlight qualitative sampling of pond and wetland habitats and the ecology and natural history of their invertebrate inhabitants.

To effectively participate in, and enjoy, the field excursions, you will need to be prepared for **wading in winter conditions**. We will provide waders or hip-boots, but strongly encourage you to bring your own gear if you have it. Despite our best efforts, some of our equipment leaks. All necessary collecting equipment (i.e. nets, vials, and a notebook) will be provided.

When sampling, we ask that you put safety first and be conscious of the conditions in which you wade. Do not put yourself or your classmates in danger. No collection is worth it!

Laboratory Experiences

The laboratory experiences are designed to both provide practice in identifying freshwater invertebrates and a realistic experience in sample processing. Each laboratory experience will start with a lecture that introduces a taxonomic group and will conclude with time working on identifying both reference specimens and individuals you have collected. Over the course of the semester you will be required to create a lab manual containing taxonomic resources. We have found that a three-ring binder works best to keep all handouts and identification keys organized.

Some portion of the laboratory will also be spent processing your samples. This exercise is designed to introduce you to data quality issues and how various sources of variation in the organisms you sample can influence inferences. You will be expected to follow standard laboratory sample processing protocols that we provide you that will include subsampling, sorting, identification, and data compilation.

Classroom, Departmental, and University Policies

Cell phones, laptops, and other electronic communication devices – Active use of cell phones and laptops is prohibited in the classroom and during field trips except that you may use your laptop during lab sessions when you are entering or analyzing data. Cell phones must be turned off and stowed out of sight for the duration of every class. If someone needs to contact you during class, they can call the Watershed Sciences Department (435-797-2459).

Students with disabilities – Accommodations are collaborative efforts between students, faculty and the Disability Resource Center (DRC). Students with accommodations approved through DRC are responsible for contacting the course instructors prior to or during the first week of the semester to discuss accommodations. Students who believe they are eligible for accommodations but who have not yet obtained approval through DRC should contact DRC immediately at 797-2444.

Academic Dishonesty – This course follows the University rules on civility and honesty. These can be found at http://www.usu.edu/policies/PDF/Acad-Integrity.pdf.

USU defines **cheating** as "intentionally: (1) using or attempting to use or providing others with any unauthorized assistance in taking quizzes, tests, examinations or in any other academic exercise or

activity; (2) depending upon the aid of sources beyond those authorized by the instructor in writing papers, preparing reports, solving problems or carrying out other assignments; (3) substituting for another student, or permitting another student to substitute for oneself, in taking an examination or preparing academic work; (4) acquiring tests or other academic material belonging to a faculty member, staff member or another student without express permission; and (5) engaging in any form of research fraud." **Falsification**, "includes the intentional and unauthorized altering or inventing of any information or citation in an academic exercise or activity." **Plagiarism**, "includes knowingly representing, by paraphrase or direct quotation, the published or unpublished work of another person as one's own in any academic exercise or activity without full and clear acknowledgment. It also includes the unacknowledged use of materials prepared by another person or agency engaged in the selling of term papers or other academic materials." (This includes internet sources.) The penalty for cheating in this class will be a zero grade for the exam or assignment in question. In addition, the offense will be reported to the Office of Student Conduct for inclusion in the student's permanent record.

Course Schedule						
	Dates	Tuesdays		Thursdays		
		Lecture / Discussion	Lab	Lab / Field	Reading	Important Dates
	Jan 10/12	Introduction	Inroduction to lab and tour of the BugLab	Sampling gear and sampling / Introduction to taxonomy	M&C 2, 3	
	Jan 17/19	Course project	Order level taxonomy / prepare for field	**Field Trip 1**	T&C 1, M&C 8	
Paper 1 topics	Jan 24/27	Phylogeny and evolution	Ephemeroptera sample 1 processing	Sample 1 processing	M&C 4, 5; TC 2	
	Jan 31/ Feb 2	Adaptations and niches	Plecoptera sample 1 processing	Sample 1 processing	Ward 2, R&R 5	Intro material exam
	Feb 7/9	Adaptations and niches	Trichoptera lecture	**Field Trip 2**		
	Feb 14/16	Drift	Diptera	Complete EPT for Sample 1 / Start processing Sample 2		Paper 1 16 Feb
	Feb 21/23	Monday schedule	Monday schedule	Sample processing		
Paper 2 topics	Feb 28/ Mar 2	Population regulation	Mid-term lab exam review and Coleoptera	Midterm Lab Exam and sample processing		Lab midterm 2 Mar
	Mar 7/9	Spring Break	Spring Break	Spring Break	Spring Break	
	Mar 14/16	Populations and communities	Complete samples	Complete samples		
	Mar 2/23	Biodiversity patterns 1	Hemiptera and Odonata	Start data entry / work on personal collection		
	Mar 28/30	Biodiversity patterns 2	Personal collection	**Field Trip 3**		Paper 2 30 Mar
Paper 3 topics	Apr 4/6	Environmental alteration	Mollusca and Crustacea.	ID qualitative samples from lentic system		

	Apr 11/13	Biological assessment	All other non-insects (Annelids, Mites).	**Field Trip 4**		
	Apr 18/20	Biological assessment	ID qualitative samples from wetland system	Work on personal collections and project		
	Apr 25/27	Restoration	Work on personal collections and project	Project discussion		Paper 3 and personal collection 27 April
	May 4		Lab Final: 1:30-3:20			Lab Final 4 May