Taxonomy and Natural History of Southern Appalachian Mayflies, Stoneflies, and Caddisflies
Session1: 14–25 June 2021
or
Session2: 28 June–9 July 2021

SYLLABUS

COURSE DESCRIPTION: Natural history and taxonomy of mayflies (Ephemeroptera), stoneflies (Plecoptera), and caddisflies (Trichoptera), including systematics, ecology, and behavior of larvae and adults, with emphasis on those aspects important in ecological studies, biological monitoring of water quality, and sport fishing. Insects will be collected from mountain stream habitats, and identifications will be done in the laboratory.

Prerequisites: Students are expected to have prior training in zoology, but not necessarily entomology.

OBJECTIVES: To learn

(1) the literature, characters, and methods for identification of EPT larvae (at least to genus) and adults (at least to family);
(2) morphological, physiological, and behavioral modifications for life in the water;
(3) life history characteristics and habitat preferences of the different EPT groups;
(4) a variety of qualitative and semi-quantitative collecting techniques appropriate for the biological monitoring of water quality.

INSTRUCTOR: J.C. Morse (864-656-5049, jmorse@clemson.edu)

LECTURES: All lectures will be 50 minutes in duration.

LABORATORIES: All scheduled laboratories and field trips will be 180 minutes. The instructor will be available to assist with identifications on weekdays for as long as he is needed.

COLLECTION: Each student will be responsible for submitting an identified collection of EPT larvae. A collection of at least 60 correctly identified and curated genera (larvae) and families (adults) will be evaluated as "Excellent." Specimens will be collected during scheduled field trips and on students' personal time; identification and curation of specimens will be accomplished during laboratory sessions and on students' own time.

EVALUATION: Student evaluation will be based 50% on a final written and practical examination, 50% on the collection.

REQUIRED TEXTS:

Merritt, R.W., K.W. Cummins, and M.B. Berg, editors. 2019. *An Introduction to the Aquatic Insects of North America*, *5th Edition*. Kendall/Hunt Publishing Company, P.O. Box 539, Dubuque, Iowa 52001. Available without bookstore markup from https://he.kendallhunt.com/product/introduction-aquatic-insects-north-america [The FIFTH EDITION of this book enables identification of genera of both the aquatic and aerial forms of the freshwater insects in North America and includes updated ecological tables.]

Morse, J.C., W.P McCafferty, B.P. Stark, & L.M. Jacobus, Editors. 2016. *Larvae of the Southeastern USA Mayfly, Stonefly, and Caddisfly Species. Biota of South Carolina*. *Vol 9*. PSA Publishing, Clemson University, Clemson, South Carolina, USA. 482 pp. Available from https://secure.touchnet.net/C20569_ustores/web/store_cat.jsp?STOREID=168&CATID=298&SINGLESTORE=true

EQUIPMENT AND SUPPLIES:

Provided by Highlands Biological Station

Microscope - With magnification of 6.7 to 80 X.
Light source - Incandescent.
Alcohol preservative.
Because you are more likely to be familiar with their operation and peculiarities, you may prefer to bring your own dissecting microscope and light source.

Provided by Clemson University or Highlands Biological Station

Watch glasses.
Kick screens.
Benthic nets.
White pans.
Brass sieves - #10 and #30.
Vials (but see note below)
Notebooks (providing PowerPoint lectures and supplemental information).

Provided by Student (in additional to required texts)

(1) Waders or sturdy wading shoes suitable for kicking stones (felt-covered soles help prevent slipping on slick rocks but newer alternatives that do not spread fish diseases are reportedly now available and recommended)

(2) Field-collecting forceps (sturdy, fine point, cheap) (e.g., fine-point, straight-tip, stainless-steel forceps, 115 mm long, BioQuip http://www.bioquip.com/html/view_catalog.asp , page 30, Catalog Number 4731). (A lanyard or float attached to these forceps will help prevent losing them in the water.)

(3) Very fine-point laboratory forceps (2 pairs recommended: 11–13.5 cm long, with "biologie" to very fine tips (0.10X0.06 mm to 0.05X0.01 mm) (e.g., Dumont SS Forceps—Dumoxel-Biologie, Fine Science Tools

http://www.finescience.com/commerce/catalog/srhkeyword.cz;jsessionid=2382C7F0BCDCCF34B9E3D69FB4CDC9C1 , Catalogue Number 11200-33).

(4) Very fine-point, indelible-ink pen (for writing labels) (e.g., Pigma pen, black, 0.2 mm #005, available at art supply stores or at BioQuip http://www.bioquip.com/html/view_catalog.asp , page 34, Catalog Number 1154E).

(5) Vials (optional, see below)

(6) Any other equipment/supplies you have found useful for collecting or identifying aquatic insects.

VIALS:

Vials for student collections will be provided, if desired. Those students for whom vials are provided will contribute their collections to the Clemson University Arthropod Collection and the Highlands Biological Station Nature Center.

Students who provide their own vials will be able to retain most of their collections (up to 7 specimens may be kept by the CUAC and the HBS Nature Center).

If your laboratory has not yet begun maintaining a voucher collection, this will be a good opportunity to initiate this legally and scientifically significant resource. The Clemson University Arthropod Collection stocks and uses archival-quality vials: 4-dram screw-cap vials, each cap with a conical polyethylene liner that fits inside the lip of its vial, and recommends this style for permanent, archival storage of alcohol-preserved specimens [e.g., BioQuip http://www.bioquip.com/html/view_catalog.asp , page 17, Catalog Number 8804P for the vials and caps; ordered by the gross (= a dozen dozen) for a discounted price of US$86.64/gross (i.e., US$7.22/dozen X 12).] Other types of seals on the vials either allow evaporation or introduce specimen-damaging chemicals into the alcohol.

COURSE OUTLINE:

Freshwater biotopes, habitat type, river continuum concept.

How to collect and preserve larval mayflies, stoneflies, and caddisflies (Ephemeroptera, Plecoptera, and Trichoptera = EPT) and other aquatic insects.

DNA Barcoding and Barcode of Life Database (BOLD) (optional)

Insect morphology and special adaptations for aquatic life.

Orders of aquatic insects.

Evolution and natural history of mayflies (Ephemeroptera).

Identification of larvae of Ephemeroptera families.

Identification of larvae of southeastern Ephemeroptera genera.

Evolution and natural history of stoneflies (Plecoptera).

Identification of larvae of Plecoptera families.

Identification of larvae of southeastern Plecoptera genera.

Evolution and natural history of caddisflies (Trichoptera).

Identification of larvae of Trichoptera families.

Identification of larvae of southeastern Trichoptera genera.

Using Rapid Bioassessment Protocols and an EPT Index to monitor for pollution of southeastern streams.

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SCHEDULE:
Also, one night of light trapping for adult EPT will be arranged, considering optimal weather conditions.

Mon	0830	Lecture I:	Introductions, course objectives, schedule, evaluation procedures. Freshwater biotopes, habitat type, river continuum concept.
	1000	Lecture II:	How to collect and preserve larval mayflies, stoneflies, and caddisflies (Ephemeroptera, Plecoptera, and Trichoptera = EPT) and other aquatic insects.
	1300	Field Trip:	Collecting EPT in an Appalachian third-order stream (East Fork Overflow Creek).
Tue	0800	Lecture III:	Insect morphology and special adaptations for aquatic life.
	1000	Lecture IV:	Orders of aquatic insects.
	1300	Laboratory:	Insect morphology and diagnosis of orders of EPT larvae.
Wed	0800	Field Trip:	Collecting EPT in a fifth-order stream (Chattooga River).
	1300	Lecture V:	Evolution and natural history of mayflies (Ephemeroptera).
	1430	Lecture VI:	Identification of larvae of Ephemeroptera families.
	1600	Laboratory:	Identification of larvae of Ephemeroptera families.
Thur	0800	Lecture VII:	Identification of larvae of southeastern Ephemeroptera genera.
	1000	Lecture VIII:	Identification of larvae of southeastern Ephemeroptera genera and of adults of families.
	1300	Laboratory:	Identification of larvae of southeastern Ephemeroptera genera and of adults of families.

Fri	0800	Field Trip:	Collecting EPT in a fourth-order stream (Whitewater River).
	1300	Lecture IX:	Evolution and natural history of stoneflies (Plecoptera).
	1430	Lecture X:	Identification of larvae of Plecoptera families.
	1600	Laboratory:	Identification of larvae of Plecoptera families.
Sat	0800	Laboratory:	Identification of collections.
	1300		Personal time: The laboratory will be open to enable course participants to collect and identify specimens.
Sun	All day		Personal time. The laboratory will be open to enable course participants to collect and identify specimens.
Mon	0800	Field Trip:	Collecting EPT in a third-order stream (East Fork Chattooga River) and a first-order stream source (unnamed tributary of Wash Branch).
	1300	Lecture XI:	Identification of larvae of southeastern Plecoptera genera.
	1430	Lecture XII:	Identification of larvae of southeastern Plecoptera genera and of adults of their families.
	1600	Laboratory:	Identification of larvae of southeastern Plecoptera genera.
Tue	0800	Lecture XIII:	Evolution and natural history of caddisflies (Trichoptera).
	1000	Lecture XIV:	Identification of larvae of Trichoptera families.
	1300	Laboratory:	Identification of larvae of Trichoptera families.
Wed	0800	Lecture XV:	Identification of larvae of southeastern Trichoptera genera.
	1000	Lecture XVI:	Identification of larvae of southeastern Trichoptera genera and of adults of their families.
	1300	Laboratory:	Identification of larvae of southeastern Trichoptera genera and of adults of their families.
Thur	0800	Field Trip:	Using Rapid Bioassessment Protocols and an EPT Index to Monitor for pollution of southeastern streams (Ravenel Lake outflow).
	1300	Lecture XVII:	Using Rapid Bioassessment Protocols and an EPT Index to Monitor for pollution of southeastern streams.

	1430	Laboratory:	Identification of larvae and adults of southeastern EPT.
Fri	0800	Examination (1):	Closed-book examination on lecture information and reading assignments.
	0900	Examination (2):	Practical, open-book identification of Southern Appalachian EPT larvae to genus [or optional SFS Taxonomic Certification Program Level 2 (genus-level), Eastern Group 2 (EPT) examination – Participants must register separately for this option at least 10 days before Exam day [registration at https://stroudcenter.org/sfstcp/exam/ or https://stroudcenter.org/sfstcp/exam/schedule/].
			Collection submission.
	1200	Departure:	Course Participants.
	1300	Examination:	SFS Taxonomic Certification Program Level 2 (genus-level) Exam. This examination will be provided for anyone, including persons who did not undertake the EPT course, but who wish to attempt certification for any Group. Examinees must register for this option at least 10 days before Exam day [registration at https://stroudcenter.org/sfstcp/exam/ or https://stroudcenter.org/sfstcp/exam/schedule/].
	1600	Departure:	Second SFS Certification Exam Participants.