What Factors Affect Stream Temperature?

A Laboratory Exercise for Undergraduate Ecology Courses

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Instructor's Tips

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Learning Outcomes

1. Students will be able to describe and apply the concepts of the heat budget of a stream

2. Students will be able to employ a computer simulation model to develop and answer questions

Timing and Scheduling

- Number of labs/classes required for minimum implementation: 1
- Number of labs/classes required for optimal implementation: 1
- Faculty time needed for pre-lab preparation and trips to field: 1-2 hrs., 0 trips to the field

Students' Skills

- What biological background is needed for students to participate in this activity?
    - Familiarity with the scientific method including writing hypotheses
    - Stream heat flux

What analytical, instrumental, etc. skills are needed for students to participate in this activity?

Existing – basic spreadsheet use (e.g., Excel)
Acquired – basic modeling

Challenges to anticipate and solve:

- Students do much better in this lab exercise when I give a lecture on stream temperature regime and the heat budget equation before the day of the lab. The lecture shows the some of the model's equations, defines terms (like conduction, short-wave radiation, long-wave radiation, etc.) and makes connections among the variables (e.g., wind speed affects convection and evaporation which then affect stream temperature).

- Similarly, completing the *Stream Temperature Lab 1 – Scale* before this lab, will give the students a stronger foundation upon which to build.

- The SSTEMP program only runs in Windows™; there is no Mac version. Therefore, I usually have students work in pairs so Mac users can pair up with PC users. Alternatively, if your institution has laptops dedicated for laboratory use, you can download the software to the laptops ahead of time for students to use.

- On page 8, the following question is posed:

    "Computer models also have some potential drawbacks. Can you think of some?"

    I have had a mini-discussion in the class around this question with good results.

- Here are some more sample questions that should produce good results. Don't give these away to students; however, unless they are really stumped. One of the keys objectives of this lab is to help students learn to ask pertinent questions and then turn them into hypotheses.
    - Is there a relationship between [*any input variable*] and [*any output variable*]?
    - Which of the input variables has the greatest effect on daily maximum temperature?
    - Which of the factors that stream managers can control would be the best to use for mitigating stream temperatures?
    - How will [logging, conversion to agricultural field, pavement, channelization, buffer plantings, dams] affect daily maximum temperatures?
    - How will the temperature regime differ between small, first-order streams and medium-sized, fourth order streams?
- Instructors will need to provide guidelines for table formatting, figure formatting and running statistical tests.