Interactive Field Site Visits Can Help Students Translate Scientific Studies into Contextual Understanding

J. M. Burt \(^a\), M. R. Donaldson \(^a\), K. A. Hruska \(^b\), S. G. Hinch \(^a\) & J. S. Richardson \(^c\)

\(^a\) Pacific Salmon Ecology and Conservation Laboratory, Centre for Applied Conservation Research, Department of Forest Sciences, University of British Columbia, 2424 Main Mall, Vancouver, British Columbia, Canada, V6T 1Z4

\(^b\) Biology Department, Lángara College, 100 West 49th Ave., Vancouver, British Columbia, Canada, V5Y 2Z6

\(^c\) Department of Forest Sciences, University of British Columbia, 2424 Main Mall, Vancouver, British Columbia, Canada, V6T 1Z4

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Interactive Field Site Visits Can Help Students Translate Scientific Studies into Contextual Understanding

J. M. Burt
Pacific Salmon Ecology and Conservation Laboratory, Centre for Applied Conservation Research, Department of Forest Sciences, University of British Columbia, 2424 Main Mall, Vancouver, British Columbia, Canada, V6T 1Z4. E-mail: jenn.burt@gmail.com

M. R. Donaldson
Pacific Salmon Ecology and Conservation Laboratory, Centre for Applied Conservation Research, Department of Forest Sciences, University of British Columbia, 2424 Main Mall, Vancouver, British Columbia, Canada, V6T 1Z4

K. A. Hruska
Biology Department, Langara College, 100 West 49th Ave., Vancouver, British Columbia, Canada, V5Y 2Z6

S. G. Hinch
Pacific Salmon Ecology and Conservation Laboratory, Centre for Applied Conservation Research, Department of Forest Sciences, University of British Columbia, 2424 Main Mall, Vancouver, British Columbia, Canada, V6T 1Z4

J. S. Richardson
Department of Forest Sciences, University of British Columbia, 2424 Main Mall, Vancouver, British Columbia, Canada, V6T 1Z4

ABSTRACT: This article describes how the interactive learning methods employed during a short (1.5 h) class visit to a nearby stream engaged undergraduate students in their own exploration of riparian ecology. We describe how the use of a published field study conducted at this stream site served as an effective learning tool to help students contextualize ecological research-based findings. During the outing, students worked in groups using a “stream station worksheet” and participated in facilitated discussions to relate their observations to the findings of the published field study. An anonymous survey of students’ opinions after the site visit revealed positive responses, reflecting success in achieving the desired learning objectives. We discuss how the site visit has been enhanced from previous years to increase effective student learning and how this type of activity could be applied to other ecology or fishery courses by utilizing appropriately chosen local research.

INTRODUCTION

In many undergraduate science biology or ecology courses the standard format for instruction is classroom-based lectures, in which students have little opportunity to connect theory with practice. However, recent pedagogical research suggests that providing students with the opportunity to participate more actively in the learning process is essential to effective teaching in science education (Healey and Jenkins 2000; Michael 2006). A current trend in science education is the incorporation of experiential or active learning into science curricula, with an emphasis on student engagement and participation, creating meaningful contexts for critical and creative thinking and skills development, and augmenting activities in which students actively collect and analyze information (Montgomery et al. 1997; Ryan and Campa 2000).

Field trips are often used in ecology and fisheries courses to provide students with experiential learning opportunities. Educational researchers have suggested that field trips or field-based learning help students to better comprehend and retain core concepts and cultivate enthusiasm for the subject matter (Manzanal et al. 1999; Janovy and Major 2009; Lei 2010). Field experiences provide students with the unique opportunity to get their hands dirty and develop data collection and analysis skills, which can inspire individuals to pursue research (Janovy and Major 2009). However, the manner in which field trips are conducted is important; student learning can be more effective if field activities are well planned and involve pretrip preparedness and posttrip reflection to encourage students to discover, collaborate, problem solve, and think critically and creatively (Lei 2010).
In upper level undergraduate ecology courses, students are increasingly exposed to research findings in lectures or asked to provide references to the primary literature in project reports. However, there is often little opportunity for students to gain an understanding of how experiments are conducted or the intricacies of field-based research. There is often a great deal of research conducted by university researchers at local field sites that may complement the course material (e.g., experiments in research forests, field experiments in nearby rivers or streams). Exposing students to these research settings may provide an excellent opportunity to foster their interest in ecological research as well as help root their theoretical understandings of course content in applied contexts.

Herein we discuss a case study that (1) describes how interactive activities can be used during a field site visit to engage third-year students in learning about stream–riparian processes and small stream fish ecology and (2) demonstrates how centering this site visit around a published field study may provide a unique way to help students contextualize the scientific processes involved in field-based ecological research.

DEVELOPING A FIELD SITE VISIT: BACKGROUND TO THE MUSQUEAM CREEK OUTING

In the third-year University of British Columbia (UBC) undergraduate course Aquatic Ecosystems and Fish in Forested Watersheds, students examine stream, riparian, and forest ecosystems and study the processes and interactions that govern the dynamics of those processes. Particular focus is placed on the ecology and habitat requirements of salmonid fishes, with several lectures and labs emphasizing how forest practices such as riparian logging, the construction of roads and stream crossings, and the removal of large, instream wood can impact stream dynamics, which impact fish habitat and populations. In order for students to complement this knowledge with findings from published field research, students were asked to read the well-referenced article by Fausch and Northcote (1992), who studied the effects of forest practices on stream habitat and juvenile salmonid density. This paper was purposefully chosen for the relevance of its content but also because the study’s field site, Musqueam Creek, was conveniently located only 5.8 km from UBC’s Vancouver campus in British Columbia, Canada. This site was furthermore applicable to the course material because it is one of the last remaining urban streams in Vancouver that contains a naturally sustaining salmonid population and it provides observable examples of restoration efforts.

The overall goal of the site visit was to help students connect with the process of science in field ecology through relating the journal article to their field observations. This site visit also provided students with the opportunity to apply their lecture knowledge to a real stream environment where the effects of past forestry practices and recent restoration efforts were observable. The learning objectives for the site visit are provided in Table 1.

Instruction during the Site Visit

Prior to the outing, students were asked to read the paper by Fausch and Northcote (1992) and write a summary paragraph (collected at the start of the site visit) outlining the study’s primary research questions, general methods, and principal findings. In this study, the authors compared stream reaches that had been cleared of large wood during park maintenance in the 1960s and 1970s (“simple” sites) to stream reaches that were left relatively undisturbed by forestry practices (“complex” sites). Their principal findings were that, as a result of large wood debris removal, simple stream sites were wider and less sinuous, had less pool volume and overhead cover, and contained less fish habitat resulting in lower fish biomass.

The site visit required 1.5 h and was facilitated by two teaching assistants who informally guided the students to a total of four predetermined “observation sites” along a 200-m section of the stream. Students worked in small groups of three or four and were given “stream station worksheets” for taking notes and guiding some of the observational activities at the sites (see supplementary material at http://www.tandfonline.com/UFSSH). At each site, students were given time to make observations and work through the worksheet questions and activities. Teaching assistants then facilitated a discussion centered on the students’ discoveries, conclusions, and questions.

At two of the observation sites, students were engaged in an activity related to the Fausch and Northcote (1992) Musqueam Creek study (learning objectives 1 and 2). Students visited one simple and one complex site and made observations regarding stream features that distinguished the sites from each other. For example, students frequently observed that the stream sinuosity was lower at the simple site. Students were not told which site was simple and which was complex but were asked to make this determination for themselves by sketching each stream reach and describing the instream features and habitat characteristics. During the discussion that followed, the students were asked to defend their decisions regarding which site was simple and which was complex using their observations as evidence. Students were also asked to critically discuss the methods and findings of the paper.

The site visit also took advantage of two other observation sites that demonstrated stream ecology processes learned during lectures. At the first site, students viewed a location where a road crossed the stream over an open-bottom culvert that had recently been modified from a non-embedded corrugated metal pipe. Here, they discussed the history of human alterations to Musqueam Creek and students observed/discussed the effects of stream road crossings and culverts on stream habitat and fish populations (learning objective 3). The fourth observation site served to illustrate the goals and techniques involved in stream restoration. In the past two decades, following the time in which the study was conducted, the stream has undergone many changes in response to local restoration efforts to enhance stream complexity. Students visited and made observations in a section containing log and boulder structures. They were given
a flowchart that depicts a “hierarchical strategy for prioritizing specific restoration activities” (Roni et al. 2002) which served as a focal point for a facilitated discussion on the central concepts and processes involved in stream restoration (learning objective 4).

**Student Feedback on Musqueam Creek Visit**

In 2009, students were asked to complete an anonymous and optional survey to provide feedback to the instructors. The survey consisted of five questions that required students to rate how well the learning objectives were met and to provide information about their overall learning experience. Out of 78 students, 39 (50%) survey responses were returned and tabulated (Figure 1).

**OBSERVATIONS AND DISCUSSION**

In recent years, this field site visit has been redesigned to transform the outing away from its original “guided stream walk”—in which instructors mostly lectured to students as they toured past various stream locales—to a more interactive experience. The first of these activity modifications was to provide students with clear learning objectives. This helped students to know what to expect from the field site visit and prepare them for later examination on material related to the site visit. The second modification was to switch from simply asking students to read the Fausch and Northcote (1992) study to requiring them to hand in a summary of the article’s methods and principal findings. We found that, as a result of this small assignment, in comparison to previous years, students seemed better prepared to engage in a study design discussion and articulate their conclusions about the simple and complex stream reaches.

The third modification involved placing the instructor in the role of a facilitator rather than as a knowledgeable tour guide. The site visit was redesigned so that students would work in groups to actively make their own stream observations. This activity modifications was to provide students with clear learning objectives. This helped students to know what to expect from the field site visit and prepare them for later examination on material related to the site visit. The second modification was to switch from simply asking students to read the Fausch and Northcote (1992) study to requiring them to hand in a summary of the article’s methods and principal findings. We found that, as a result of this small assignment, in comparison to previous years, students seemed better prepared to engage in a study design discussion and articulate their conclusions about the simple and complex stream reaches.

The Musqueam Creek site visit is an example of a short (~1.5 h) and logistically simple activity that has helped to get students out of the classroom and actively engaged in learning about field-based research and stream/riparian ecology. The basic model of this study site visit could easily be adapted by ecology and fisheries instructors who have field sites or laboratories associated with published or continuing research that aligns with a particular course’s subject matter. Many universities are affiliated with research stations or land where graduate students actively conduct research, often within close proximity of the university itself. The site visit described here could easily be adapted to enable undergraduate students to read relevant research papers in preparation of a site visit where they can experience and learn from the actual locations where the data were collected. Alternatively, if such research facilities are not in close proximity to the university, there may be city parks and

**TABLE 1. Learning objectives for the Musqueam Creek field site visit.**

<table>
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<tr>
<th>By the end of the visit, the student should be able to:</th>
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<tr>
<td>1. Discuss and critique the methods and findings of the Fausch and Northcote (1992) study with reference to their own observations from the Musqueam Creek study field site.</td>
</tr>
<tr>
<td>2. Identify stream characteristics (e.g., habitat or channel units, sinuosity, wetted channel and bank-full widths, flow dynamics, canopy cover, substrate material, bank stability, fish habitat) at two different sites and discuss the influence of stream clearing practices (large wood removal) on these characteristics.</td>
</tr>
<tr>
<td>3. Identify at least three effects of stream crossings on channel characteristics and fish movement.</td>
</tr>
<tr>
<td>4. Identify the primary objective of stream restoration and list at least three restoration strategies that can be used to achieve this goal.</td>
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</table>
Figure 1. Student survey responses to learning outcomes for the Musqueam Creek site visit. Questions 1–4 asked whether students agreed that each learning objective (see Table 1) was met (SD = strongly disagree, D = disagree, N = neutral, A = agree, SA = strongly agree). The fifth question asked students to rate their overall learning experience on a scale from 1 = “bad learning experience” to 9 = “great learning experience.” A score of 5 was neutral; a score of 7 indicated a “good learning experience.”
other natural habitat nearby the university where students can read a relevant paper and engage in an interactive site visit that is designed to clarify key terminology and research methods. Students will not only benefit from a more engaged learning of course-related material, but site visits may aid in fostering interest to be involved in future field courses and research endeavors.

In general, student survey responses expressed a positive attitude toward the Musqueam Creek field site visit, with the majority scoring the outing as 7 out of 9 in terms of overall learning experience. The survey revealed that the majority of students found that activities during the site visit helped them to better contextualize the Fausch and Northcote (1992) paper and to better understand stream processes and assessment terminology. An optional comments section on the survey sheet revealed that some students felt very positive about the field trip, with comments such as, “a nice change from indoor labs,” and “a good time frame, not too short or too long, definitely reinforced the Fausch and Northcote paper.” The survey responses and the survey comments, in addition to informal discussions with students after the site visit, suggested that the site visit was an enjoyable experience and was successful in achieving the outlined learning objectives.

Though feedback was generally positive, commentary from several students indicated that they would have liked the site visit to be even more involved and hands on (i.e., participating in an actual stream assessment, collecting habitat data, reconducting the Fausch and Northcote study, etc.). Unfortunately, this level of involvement is likely better than the scope of an activity/outing scheduled during limited class hours (2-h time block). In addition, many other field courses are available in which students have the opportunity to be more involved with research methods and data collection.

In conclusion, associating the traditional classroom lecture with course-related ecological concepts in the field can be a fruitful learning experience. In this case, a site visit to Musqueam Creek helped students to become more familiar with stream habitat characteristics, observe forestry impacts on streams and subsequent restoration activities, as well as contextualize the methods and relevant findings of a published stream ecology study. With the use of an appropriately chosen local research article or field site, the opportunity to directly connect undergraduate students with the scientific process and a peer-reviewed journal article can be applied to many other ecology courses.

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