

Out in the Field: A Natural Integration of History, Landscape, Engineering, and the Environment

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Place-Based Inquiry

Place-based inquiry provides a natural opportunity to integrate traditional scientific and engineering research with the liberal arts. In contrast to the controlled environment of the lab, the uniqueness of a site calls for an understanding of history, politics, culture and landscape. When structured appropriately, place-based inquiry fits easily into a learner-centered paradigm that puts emphasis on student learning, rather than instructor teaching. Under such a paradigm, students construct knowledge through integrating information with critical-thinking and problem-solving skills,

and they use and communicate this knowledge to address real issues [Huba and Freed, 2000]. Connecting abstract concepts from the natural sciences, social sciences, and humanities to a common place and a shared set of field experiences deepens one's understanding and appreciation of those concepts. Our efforts in Monteverde, Costa Rica and Whately, MA provide examples of this natural integration.

[Huba, M. E. and J. E. Freed, 2000. Learner-Centered Assessment on College Campuses, Allyn and Bacon, Boston.]

Ada and Archibald MacLeish Field Station, West Whately, MA

In May 2008, Smith College dedicated the Ada and Archibald MacLeish Field Station in West Whately, MA. This 200-acre site is located adjacent to the primary reservoir that supplies drinking water to the City of Northampton and amid a patchwork of protected land and farmland making up one of the largest tracts of undeveloped acreage in the state. The site will facilitate research and education, and over the past two years a number of projects have been initiated and undertaken at the site:

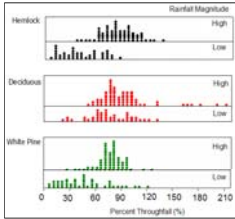
- Alex Webster '08 used the site for her honors thesis on throughfall variability
- A Landscape Studies studio course designed a proposed trail network for the site.
- The Exercise and Sports Studies Program has used the site for its outdoor education courses.
- Science and engineering students have carried out hydrologic and geochemical studies.
- Laura Paul AC '09 investigated the history of the site.

All of these efforts complement and build on each other, emphasizing the value of integrating knowledge across disciplines.

Throughfall Variability

During the academic year 2007-2008, Alex Webster '08 carried out a preliminary throughfall investigation in Whately, MA. Over eight measurement periods from 19 October to 29 November, she measured open precipitation and throughfall in three forest stands: eastern hemlock, deciduous, and white pine.

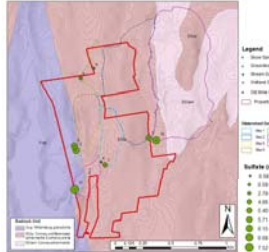
Open precipitation for the duration of the study totaled 166.8 mm. Total throughfall percentages for the hemlock, deciduous, and white pine stands were 76%, 82%, and 80%, respectively. Throughfall volumes were highly variable in space, with some collectors receiving over 200% of incident precipitation, and throughfall percentages were lower for less intense events. The deciduous stand exhibited greater within-stand spatial variability in throughfall fraction and less event-to-event temporal variability than the hemlock and white pine stands.



Throughfall percentage as a function of rainfall magnitude and stand type (eight events, 25 collectors per stand). Open precipitation for the three low-magnitude events totaled 6.0 mm, 4.2 mm, and 1.2 mm. Precipitation for the five high-magnitude events totaled 33.2 mm, 30.4 mm, 17.8 mm, 35.0 mm, and 39.0 mm. (From Webster, A., 2008. *Effect of Stand Characteristics on Throughfall in a New England Forest*. Honors Thesis, Smith College, with permission).

Whately Pottery

Redware pottery and bricks were made by early settlers from clay found along the banks of the Mill River and the Great Swamp Brook. Finely ground clay was added to lead from the lead mines found on the MacLeish site along with coloring elements, such as manganese, desired to make glazes for the pottery. Because of the English Embargo which stopped the importing of pottery, Whately area residents used more of the locally made pottery than any other to store their foodstuffs. A Connecticut doctor diagnosed illness among the Redware users as "bilious colic". He attributed it to locally made pottery containing "LED". Subsequently lead-free clay was obtained from Berlin, CT and New Jersey. (Baldwin) Thomas Crafts and many of his family were major producers of area pottery. David Dempsey, of the Department of Art at Smith College, used the Portable X-Ray Florescence Instrument (XRF) to measure the amounts of lead and iron in several pottery pieces from local museums and historical societies. [Information compiled by Laura Paul AC '09]



Sulfate concentrations are higher to the west, suggesting sulfide bearing minerals may be contributing to the stream water. Mineralization of pyrite (FeS₂) and galena (PbS) occurred at the schist-granodiorite contact, also where the mines are located. [Produced by Jenna Zechmann '12 and Mary Gowins '11]

Examples of Student Outcomes

"Tromping through the underbrush, taking notes under the shelter of a tree in a rainstorm, looking up from my measurements to see a bear wandering among the trees – This is how to learn not just about ecology, but about your place in the world. These woods behind us taught me many lessons. It was immediately obvious when I left the classroom and spent time in these woods that the narrow disciplines we peg ourselves to have very little application to how forests really work. I am a biology student, but in order to study how water comes into this forest, as I did for my thesis, I worked with faculty and students from the engineering, biology, geology, and statistics departments at Smith." Alex Webster '08 (from her remarks at the dedication of the Ada and Archibald MacLeish Field Station)

"Since much decision-making was on our shoulders, especially when out in the field, the four of us really had to work together to figure out what to do and what is best for the project. This responsibility fostered a sense of ownership and a sense of devotion to the project." June Yeung '07

"The most valuable lesson in this... is how I learned that a sustainable future... needs to be technologically, economically, scientifically, politically and culturally feasible. In order to pursue a more sustainable future, we have to be able to consider all these aspects carefully. Because I am not able to specialize in engineering, biology, government, economics, and sociology all at the same time, I now realize the importance of having enough specialized knowledge [and] being able to collaborate with people in different fields." Mai Kobayashi '06

"Having met several employed, capable, and smart Costa Ricans without high school diplomas, I found myself asking for the first time in fifteen years of education what it means to be educated... I think it is important to have a variety of learning experiences and environments: classroom, laboratory, and field. Each requires different tools, preparation, and organization, allowing one to develop the skills needed to analyze and act effectively in a variety of situations." Liz Koenig '05

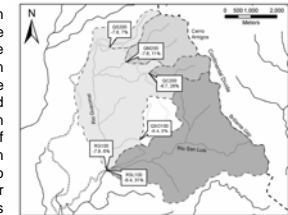
"Learning by doing creates an understanding of a topic that goes far beyond facts. It creates a deeper understanding of the context of the subject and serves as an opportunity to learn about oneself in many ways. Another consequence for me this summer was a better realization of how science, other disciplines, and everyday life overlap. Our research was pertinent to every person in Monteverde, everyday. Everyone depends on the water resources. It was exciting to see that connection and know what we were doing was so relevant." Merilee Reynolds '08

"Back in my first year at Smith, I always wondered how I was ever going to complete the engineering Latin Honors [distribution] requirement. In a way, classes such as art and history always seemed extraneous; they were 'filler' classes. My Team Aqua experience and my three years of college have taught me otherwise, however. Being in Monteverde has shown me how a community can be shaped by so many different forces. It seems like, in real life, very few things are truly divided into majors." June Yeung '07

Water Resources of Monteverde, Costa Rica



From 2000-2006, Professors Guswa and Rhodes worked with twelve undergraduates from Smith College to characterize the hydrologic and geochemical fluxes on the Pacific (leeward) slope of the Continental Divide in Monteverde, Costa Rica. This region is home to tropical montane cloud forests that exemplify the delicate balances among climate, hydrology, habitat, and development, and a boom in tourism has put significant stress on water resources. Specific projects included an assessment of stream chemistry, a comparison of throughfall variability in primary and secondary forests, and the use of stable isotopes to assess the importance of dry-season precipitation to water supplies. While in Costa Rica, students stayed with local families and logistical support was provided by the Monteverde Institute (a Costa Rican, nonprofit educational and research association that serves as both an international, interdisciplinary study center and a local educational and cultural center).



Spatial variability of the temporally averaged $\delta^{18}\text{O}$ value (per mil) along with the fraction of drier-season precipitation that would contribute to water supply in each catchment. [Guswa et al., 2007, *Adv. in Water Res.*, 30, 2098-2112]

