

3-15-2017

# Developing a Long-Term Environmental Monitoring and Education (L-TEME) Site at the Beebe River

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## Recommended Citation

Villamagna, Amy and O'Donnell, Brigid, "Developing a Long-Term Environmental Monitoring and Education (L-TEME) Site at the Beebe River" (2017). *Clusters*. 246.  
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## PSU Integrated Cluster (IC) Project Funding Process & Proposal Form

**Project Proposal Submittal Process:** All IC projects requesting funding will require the completion and submittal of three (3) forms:

- Project Proposal Form – project scope & outcomes** (*included in this document*)
- Project Guidelines Form – reflective document outlining desirable IC project attributes**
- Project Budget Form – Excel spreadsheet to facilitate budget planning**

### **Instructions for Submitting Project Proposals:**

- ✓ Download the 3 forms to your computer
- ✓ Complete the forms and save them; including the title of your project in the file name
- ✓ Forward the 3 files via email to the IC Project Manager, Ross Humer [rhumer@plymouth.edu](mailto:rhumer@plymouth.edu)
- ✓ Project Proposal will be logged & forwarded to the appropriate IC Guide Team

If not reviewed in advance of the submission, it is important to discuss the Project with the IC Guides to review, refine, and rework (if necessary) to obtain funding approval.

**Project Funding Review Process:** All proposed projects will be reviewed by the Cluster Guide team. Depending on the level of funding amounts being requested, the proposal request will follow the process outlined as follows:

- **Level 1:** Any project with a proposed budget of less than or equal to \$1,000 can be approved by the Cluster without additional review
- **Level 2:** Any project with a proposed budget of \$1,000 but less than \$5,000 can be approved by the IC Project Review Team, which is made up of representatives from each of the 7 Clusters (*see release time exception directly below*)
- **Level 3:** Any project with a proposed budget of \$5,000 or greater **or** requires faculty release time, must be first endorsed by the IC Project Review Team and submitted to the Academic Deans for review and approval

The project funding approvals are limited to one academic year; projects which require additional funding in subsequent years will need to be resubmitted annually for review and approval.

**Deliverables:** At the conclusion of the academic year, a deliverable to the Integrated Cluster Proposal Review Team and Academic Deans is required in order for the project director/coordinator, artist, or author and collaborator(s) to be eligible for future funding. This reporting requirement may be met by numerous means which will be identified as this process matures. It is anticipated that awardees will present their works before a wide public gathering to be scheduled during the upcoming Academic Year.

**Instructions for the PSU Integrated Cluster Project Proposal Form:** Please complete all of the elements of the following form in the spaces provided before saving and then submitting the document.

### **PSU Integrated Cluster Project Proposal Form**

**Title:** Developing a Long-Term Environmental Monitoring and Education (L-TEME) site at the Beebe River (“*Beebe River L-TEME*” for short)

**Project Leadership:** Dr. Amy Villamagna & Dr. Brigid O’Donnell

**Project Description:** The proposed long-term environmental monitoring and education (L-TEME) site program marks the initiation of long-term ecological and hydrologic monitoring program in the Beebe River watershed, a tributary to the Pemigewasset River. The research program will track freshwater and terrestrial ecological conditions and the movement patterns and genetics of eastern brook trout before and following a major restoration endeavor to restore natural flows to five south-facing Beebe River tributaries (see Beebe River FLP watershed map\_v3.jpg in [supporting resources folder](#)). Our program is multifaceted: we will continuously track in-stream conditions for benthic macroinvertebrates and coldwater fish, the presence and absence of terrestrial wildlife species, and shifts in movement and population genetics of brook trout in tandem with restoration efforts. The project will blend an array of continuously logging environmental sensors for air and stream temperature, stream stage, and specific conductance, with snapshot sampling, fine-scale in-stream habitat and riparian zone assessment, macroinvertebrate sampling, and electroshocking and tracking of wild brook trout. The project is highly collaborative in nature with off-campus partners from the NH Fish and Game Department (NH F&G), Pemigewasset chapter of Trout Unlimited (Pemi-TU), and The Conservation Fund (TCF; current easement holders and land managers). Likewise, the research and monitoring proposed reflects a collaboration of PSU faculty from Environmental Science and Policy, Biological Sciences, and Geography, with student involvement open to these and additional programs. During this summer (year 2 of our long-term monitoring plan), we plan to engage 1-2 graduate students, 3 full-time undergraduate student researchers, and 3-5 day-to-day undergraduate volunteers. In the fall, this long-term monitoring program and restoration project will be integrated into two existing PSU courses (*BIDI 1220 Ecology, Evolution and Biodiversity* and *ESP 2100 Introduction to Environmental Science and Policy*) as well and undergraduate independent studies and graduate student thesis. In the aforementioned courses, students will conduct forest/stream ecosystem assessments and biodiversity estimates as part of their required coursework. In doing such, students will contribute to a long-term monitoring program and will be building a rich dataset that students and faculty can analyze in classes and through engaged scholarship for years to come.

The project proposed here is PHASE I of this long-term monitoring program. PHASE I starts with involvement of faculty that teach students in the biology, environmental science and policy, meteorology, and geography (GIS) programs as well as students in Scientific Inquiry Directions courses. Overtime, we expect to recruit additional faculty (e.g. History, Environmental Planning, Education) to become engaged in the proposed long-term monitoring and education site (L-TEME).

### **Project Goals and Outcomes:**

**Project Goals:** The main goals of this project are two-fold. We describe these below and discuss specific objectives related to each. We envision this program as an opportunity to engage students in field research early in their PSU careers. Therefore, the coursework described and research opportunities include targeting students early in their tenure at PSU.

- 1) Develop a **long-term living laboratory and classroom** for environmental study in close proximity to PSU that will enable instructors to provide students with hands-on field experiences that will foster their development of professional skills. The parking area for this research area is only eight miles from campus, making it a fantastic location for field trips from campus. Drs. Villamagna and O'Donnell will bring students to the Beebe River Restoration site in Fall 2017 to conduct lab exercises in forest/stream assessment and biodiversity estimation, currently two dominant themes in both courses (*ESP 2100 Introduction to Environmental Science and Policy*, > 60 first year students; *BIDI 1220 Ecology, Evolution and Biodiversity*, ~40 students. Others, including Drs. Reitsma, Yurewicz, and Jolles (Biological Sciences), have expressed interest in integrating this field site into their labs as well over the next couple of years. This site will also be available to students in the GIS program through formal class instruction on GPS mapping and data processing (*GE 4140/ESP 5500 GIS Applications in Environmental Science*) and for independent research using the field data collected.
  - a. **Revise ESP 2100 and BI 1220** course plans and materials to introduce students to the Beebe River restoration project early on in their education at PSU. This revision will include the revision/creation of 3-4 lab exercises in which students learn field-based assessment techniques, data recording and organization, data synthesis and communication of results.
  - b. **Develop a teaching module in GE 4140/ESP 5500** that engages students in the mapping of real field data and challenges them to synthesize “big” data and prepare helpful map illustrations to convey trends both spatially and temporally.
  - c. **Develop a teaching module in a new ESP course focusing on Excel data management and graphing.** This course is new and will hopefully be offered to ESP majors in Fall 2017. Villamagna will work with Mary Ann McGarry (ESP Dept

Chair) to develop a list of data management and analytical skills and data collected from the Beebe River summer program can be used in class to provide a 'real-world, problem-based' application of newly learned skills.

- 2) Collect **critical field data** on eco-hydrological condition, macroinvertebrate community diversity and wild brook trout movement and population genetics *before and after* the large-scale restoration work to restore natural flows in the Beebe River. The restoration plan for this area will temporarily disturb the both freshwater and terrestrial ecosystems on site. To further our understanding of ecological resilience and assess both the impacts of disturbance and recovery, it is critical that we develop a comprehensive, long-term research program. This summer, we will focus intensively on assessing in-stream condition and macroinvertebrate communities, but will also conduct baseline assessments of vegetation in the riparian corridors, as these have direct and strong influences on aquatic condition.
  - a. Conduct **fine-resolution habitat assessment** in three focal tributaries and the main stem of the Beebe River prior to roadwork and in-stream disturbance.
  - b. Use **continuous temperature monitoring sensors (HOBOS) and snapshot thermal surveys** on a bimonthly basis to investigate the influence of air temperature and riparian condition on stream temperature.
  - c. Conduct **fish surveys via electroshocking** in partnership with NH F&G and TU to assess population abundance and spatial distribution of wild brook trout in the Beebe. These field assessments will enable us to evaluate the size and age of fish using length-weight standards and scale-based aging techniques.
  - d. Conduct baseline **macroinvertebrate surveys** by employing a combination of sampling techniques (kicknetting, rock baskets, Surber sampling, black lighting, etc.). Exposure to a diversity of sampling protocols will expose students (undergrad and grad) to techniques and build skills that will help them secure off-campus employment.
  - e. **Maintain, monitor and collect data** from a series of continuous environmental monitoring sensors across the watershed. There are currently four wildlife cameras (triggered by movement), four types of environmental sensors (air temperature, stream temperature, water level, and specific conductance), and in-stream passive antennas that record tagged fish movement. Each of these are examples of widely used equipment in the environmental fields. Therefore, students will gain "on-the-job" training that will enhance their resumes.

## 1. Student Learning Outcomes

Through this experience, the students will:

- a. Gain **highly valuable experience** as field research assistants. Seasonal field positions are among the most common opportunities available to graduates of the environmental biology and ESP undergraduate programs. The students that will be fully funded through summer research, volunteer work hours and conduct their own research projects, and/or be enrolled in the aforementioned fall courses will emerge from this program with skills they can proudly put on their resume; these skills will make them more attractive to off campus employers.
- b. Gain **confidence to work in real-world field conditions**. Field work can be physically and mentally demanding. Being exposed to field work early in their PSU careers, we expect students engaged in this project to become better time and information managers, improve organization skills, and strengthen learning strategies.
- c. Acquire the **ability to work as part of a research team** by collaborating closely with faculty members, graduate students and other undergraduates of varying backgrounds and experiences. The value of this experience cannot be overstated. Conducting summer field-to-lab research is a *transformative* experience. Ask anyone who has been fortunate to engage in such an experience. Student and faculty (life-long students) emerge from these experiences with enhanced communication skills, confidence, stronger sense of self, and stronger ties to academic, scientific, and professional communities. In addition to the research experience associated with this program, students will also be integrated into teams that involve vital and enthusiastic off campus partners, including NH Fish and Game Dept., Trout Unlimited, and The Conservation Fund. We strongly believe that this will prompt students to expand their sense of community beyond PSU, which we think will increase student retention, enhance their student experience and strengthen their ties to PSU and NH after graduation.
- d. Gain **exposure to real world problems and solutions** in environmental science for students not enrolled in science majors (*i.e.* ~40 non-science majors enrolled in BIDI 1220) to create a sense of place and engagement with the local landscape, including an emphasis on careful stewardship of our natural resources. We anticipate that we will recruit students to the project in future years that either change majors or want to devote a portion of their educational energy to contributing service on this project, regardless of major.

**Project Synopsis:** The Beebe River L-TEME (Long-Term Environmental Monitoring and Education) will create a living laboratory and classroom for research/teaching endeavors for the PSU community, emphasizing environmental monitoring and ecological restoration.

**Project Documents/Pictures/Videos On-line Archive:** Beebe River L-TEME

PSU\_IC\_Proposal <https://www.dropbox.com/sh/qdohobz0a2kxdkh/AACebjbRIPim1Cv4Ri43hZx-a?dl=0>

**Project Rationale and Impact Statement:** After being engaged in the Beebe River Restoration and Research Planning phase for the past year, we are convinced that the Beebe River site is an incredibly unique and rich educational resource for the PSU community, and has the potential to create **highly impactful learning experiences** for students in a range of disciplines. This ecologically diverse property, with its rich history as a working forest, ecological importance as home to a robust population of wild brook trout, location between the White Mountains National Forest and the intensely populated shores of Squam Lake, and close proximity to campus provide plentiful and diverse opportunities for PSU faculty and students to engage in locally relevant environmental research and teaching. Phase I of the Beebe River L-TEME (proposed here) would provide faculty that teach in ESP, Biological Sciences, Geography, Meteorology, and Sustainability programs, and in the general education program, to converge on interconnected environmental issues, and impact potentially hundreds of students at PSU each semester. Over time and with increased visibility of efforts and investment at the site, we expect faculty from other disciplines (*e.g.* Environmental Planning, History, Art, English) to join as well. We feel the current and future potential of learning and studying at the Beebe River site strongly promotes the Integrated Cluster model. Likewise, this project reflects an incredible collaboration between local (Pemi-TU) state (NH F&G), and national (TCF) external partners. As such, an investment in the proposed L-TEME site is an investment in PSU's learning model that merges experiences and possibilities with entrepreneurship and innovation (*see* [PSU Learning Model](#)). The L-TEME site will provide students and faculty with an **authentic experience** exploring **real world problems and solutions**, and help prepare members of our learning community for success. From a faculty perspective, it provides us with an opportunity to contribute to a field of worldwide relevance and local importance (environmental restoration and conservation). **Student-centered teaching** is at the core of PSU's mission; the L-TEME site provides faculty and students the opportunity to invest in student-centered teaching and support faculty in locally focused scholarship. By conducting research locally, we strengthen ties to our local community and help **build a stronger sense of place** in our students. Sense of place and **ties to the local environment** are two core values of the PSU experience. We envision that this L-TEME site will enhance student and faculty ties to the local environment, expand the community of environmental stewards, and enable us to serve the greater community by applying our expertise to a valuable area of local interest and conservation importance.

## Project Team

PSU Project Participants (essential core team participants including faculty and staff)

Name	Position/ Title	Project Role	Discipline/ Specialty	Email
Amy Villamagna	Assistant Professor of Environmental Science & Policy	Co-PI	Conservation Ecology and Spatial Analysis	amvillamagna@plymouth.edu
Brigid O'Donnell	Associate Professor of Integrative Biology	Co-PI	Integrative Biology	bcodonnell@plymouth.edu

Non-PSU Project Participants (stakeholders; partners; academic institution; etc.)

Name	Organization	Project Role	Discipline/ Specialty	Email
Ben Nugent	NH Fish and Game Dept	Fisheries Research Liaison	Fish Population Ecology	
John Magee	NH Fish and Game Dept	Fish Habitat Ecology Liaison	Fish Habitat	
Nancy Bell	The Conservation Fund	Director of TCF; Beebe River Legacy Forest Project Liaison	Land Conservation and Restoration	
Dave Pushee	Trout Unlimited - Pemigewasset Chapter	Chapter liaison and volunteer coordinator	Trout conservation and freshwater ecosystem conservation;	

			<b>environmental photographer</b>	
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**Student Participant Profile** (Identify the student population/s to be engaged in the project. Identify if this has been or is planned to be incorporated into curricula)

<b>Class/ Student Organization/ Individuals</b>	<b>Role in Project</b>	<b>Academic Level (Undergraduate or Graduate)</b>	<b>Academic Discipline</b>	<b>Total Student Population</b>
<b>ESP 2100</b>	<b>Curriculum development</b>	<b>UG</b>	<b>ESP</b>	<b>&gt;60</b>
<b>BIDI 1220</b>	<b>Curriculum development</b>	<b>UG</b>	<b>Biology</b>	<b>~40</b>
<b>GE 4140/ESP 5500</b>	<b>Curriculum development</b>	<b>UG/Grad</b>	<b>GE and ESP</b>	<b>12-15</b>
<b>ESP XXXX (1 credit modules)</b>	<b>Curriculum development</b>	<b>UG</b>	<b>ESP</b>	<b>&gt;60</b>
<b>Tyson Morrill (BI MS '18)</b>	<b>Current Graduate Research Assistant – Field Operations Supervisor</b>	<b>Graduate</b>	<b>Biology MS</b>	
<b>Nicolas Schola (Interdisciplinary Studies '18)</b>	<b>Summer Research Assistant for 2017 season</b>	<b>Undergraduate</b>	<b>Interdisciplinary Studies</b>	
<b>Griffan Nyhan (ESP '20)</b>	<b>Summer Research Assistant for 2017 season</b>	<b>Undergraduate</b>	<b>ESP</b>	
<b>Zachary Newcity (ESP' 18)</b>	<b>Summer Research Assistant for 2017 season</b>	<b>Undergraduate</b>	<b>ESP</b>	
<b>TBD</b>	<b>Daily Volunteer Research Assistants for</b>	<b>Undergraduate</b>	<b>ESP, Biology, Geography</b>	<b>3-5</b>

	2017 season			
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## **IRB (Institutional Review Board) Compliance**

IRB Compliance: <http://www.plymouth.edu/office/institutional-review-board/>

- This project DOES NOT require IRB compliance  
 This project DOES require IRB compliance (*complete below*)

IRB Approval Status:

IRB Approval Date:

Any funding approvals of IRB-required projects are contingent on obtaining IRB approval.

## **Project Management: Timeline and Milestones**

Identify the timeline for the project including start, completion, and major project milestones. A closing report will be required as a part of the project funding process.

**Project Start Date:** 5/23/2017

**Project Complete Date:** 12/20/2017

<b>Project Milestone</b>	<b>Milestone Description</b>	<b>Target Completion Date</b>
<b>Data Collection:</b> Habitat assessments	<b>Habitat assessments at three tributaries plus mainstem of Beebe River (1x/field season).</b>	<b>6/15/2017</b>
<b>Data Collection:</b> Macroinvertebrate surveys	<b>Surveys of aquatic macroinvertebrates from the three tributaries in May, June and July.</b>	<b>7/30/2017</b>
<b>Data Collection:</b> Thermal mapping	<b>Twice monthly snapshot thermal surveys of portions of Beebe River watershed from May – July.</b>	<b>7/30/2017</b>
<b>Data Collection:</b> Electrofishing for brook trout	<b>Sampling of brook trout in tributaries for PIT-tag implantation (to facilitate tracking of movement) and size/age data; three times/field season – May, June and July, in partnership with NH F&amp;G and Pemi-TU volunteers.</b>	<b>7/30/2017</b>

<b>Curriculum Development:</b> Creation of course materials using Beebe River data and integration into PSU courses.	<b>Villamagna and O'Donnell will work collaboratively to design field/lab exercises based upon data collected in spring/summer 2017 for implementation in courses for Fall 2017.</b>	<b>12/15/2017</b>
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Please identify any pre-project education or training for students, faculty, and staff that would be helpful for your project team to have in advance to begin work on a strong footing (e.g., skill training, concepts), and identify any training and education that you are willing to help provide during the preparatory period for the project team before team work formally begins.

**Student Education/ Training Requirements:** We believe this is a unique opportunity to offer students with on-the-job training. Students in ESP 2100, BIDI 1220, GE 4140/ESP 5500 and ESP XXXX will be introduced to field and geospatial analysis techniques that are widely used in the environmental research that will occur at the Beebe River L-TEME. Students engaged in research during Summer 2017 (identified above) have already taken one or more of the courses listed and have exposed to basics of fieldwork. Therefore, their focus will be on enhancing these skills and expanding their expertise with additional field equipment. Student research assistants will also develop and work through their own independent research project. Students will present at the 2018 Student Showcase of Excellence and hopefully the 2018 New Hampshire Water and Watersheds Conference, as well as in ESP 2100, to further expose first year students to research opportunities at PSU.