**Narrative Reflection on Implementing Flexible Learning Projects into Plant Ecology (BIOL 423 & 523) at East Stroudsburg University in Fall 2020  
QUBES EREN-NEON Flexible Learning Projects FMN Fall 2020  
Plants in the Human-Altered Environment (PHAE)  
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I implemented the EREN Flexible Learning Project, Plants in the Human-Altered Environment (PHAE) in my Plant Ecology course at East Stroudsburg University (ESU) for Fall 2020. Plant Ecology is an upper-level elective course within our biology program, taken both by undergraduates (BIOL 423) and graduates (BIOL 523) in the same classroom. Traditionally, this course includes a substantial hands-on research component – students collect data throughout the semester at various field sites close to campus, and analyze the compiled class data as a final project. This includes the use of forest plots that were established for the EREN Permanent Forest Plot Project (PFPP). The course includes training in quantitative skills throughout these research projects – using Excel and Pivot Tables to organize and quickly summarize data; statistical tests; and methods of presenting data in figures and tables. In Fall 2020, Plant Ecology was taught entirely remotely in Fall 2020; ESU’s COVID-19 plan for Fall 2020 was to teach the vast majority of courses online, with few students on campus or learning in person. Therefore, the research projects that usually formed the basis for BIOL 423 and 523 were not viable, and were replaced by the PHAE Flexible Learning Project.

The PHAE project was incredibly valuable this semester, to maintain the strong field ecology component that is a hallmark of Plant Ecology, as well as the quantitative skills that are built on the data the students collect.

Because the course was taught remotely, each student was responsible for individually carrying out any data collection. There was no opportunity to give students hands-on training or have them work in groups – even if students wanted to meet up of their own accord to work outdoors together on a plot, many are not local to our area, and we did not bring students back into the dorms this fall. Therefore, each student had to select their own plot, and carry out all measurements in that plot independently.

Additionally, we were not able to provide students with field equipment. Therefore, I modified some of the protocols in the PHAE modules to accommodate students who did not have access to equipment like meter tapes to measure out the sizes of plots, or DBH tapes to record the diameter of trees. These modifications allowed the basics of the PHAE modules to be completed with just a smartphone and a fabric measuring tape (like would be used to take personal measurements for clothing sizes, available for a few dollars). I also provided a printable measuring tape that could be printed on paper and taped together. These were important resources for our students – without access to research equipment from the campus labs, it was important to minimize the cost of participating in these labs for our students, and to adapt the modules so they could be completed without additional equipment costs imposed on the students.

It is possible that these methodological adaptations reduce the accuracy of the measurements – using a phone compass and your knowledge of the length of your own stride will not outline a 20 x 20 meter plot as precisely as using a compass, measuring tape, flags, and two people. Some EREN projects might not be feasible to carry out with these equipment substitutions, especially if the goal is to produce a dataset that can contribute to collaborative research and publications in future. With that in mind, it might be helpful to have alternate low-cost or no-equipment methodologies build into the Flexible Learning Project modules where possible, or to have a project that is specifically developed with that in mind and would be the recommended choice for 100% remote learning labs. It would also be helpful to have data validation or quality guidelines for the projects (similar to the data quality levels in the EREN Permanent Forest Plot Project), so that in-person and remote courses can each target the methodology and quality that is possible within their course structure. Especially when each student was conducting all their measurements independently, it was difficult for me to assess the accuracy of their submitted data – both because of the challenges in measuring accurately without the appropriate equipment, and more broadly, determining whether or not they truly understood the methods, could identify species correctly, etc.

I developed a few additional tools for the PHAE project that were helpful for my Plant Ecology students in working through these modules remotely and independently. First, I established Google Forms for all data entry, which carefully restricted the allowed formats for each data type. For instance, students would not be able to submit the form if they typed “10 cm” instead of “10” for a diameter measurement, and the form would notify them of what needed to be changed to have the correct format. This saved a great deal of time in data cleaning on my end, and made it easier to redistribute the compiled class data for analysis. I also filmed a series of demonstration videos to show students how to use the tools they would need to get through the field and data analysis portions of the lab – a demonstration of the use of iNaturalist to identify their tree species, as well as demonstrations of how to use Excel functions and pivot tables to summarize the large dataset quickly, as well as how to make figures and carry out statistical analyses. Video demonstrations like this might be helpful to include with future Flexible Learning Projects (especially for the early PHAE modules, where there is substantial use of Google Earth).

I provided the students with a pre-summarized data set from the NEON Woody Vegetation Structure dataset, in which I summarized species richness, diversity, and tree abundance across all plots within each NEON ecodomain. I additionally derived some climate variables for each of these ecodomains from GIS layers (temperature, preciptitation, etc.) to complement the environmental data the students obtained for their own sites in the PHAE modules. The class was then able to use the NEON data and compare it to their PHAE data to explore how different factors influence species richness at different spatial scales (e.g., climate data may be informative at the national scale across NEON ecodomains, but is less informative within the scope of our PHAE plots, which all experience similar climate conditions). Understanding emergent patterns at different spatial scales is often a challenge for students in this course, and the PHAE-NEON comparison was really helpful in illustrating that point.