In ecology, it is quite easy to take students into the field and teach them basic methodological skills in data collection. However, the data that we collect in a laboratory setting is often limited in scope. I believe this is a challenge in developing broader critical thinking skills in ecology students. Additionally, there is a vast growing field of ecological research driven by 'big data' attempts to critique and analyze long standing ecological concepts on regional, continental and global scales. In building the next generation of scientists, I feel it is essential that quantitative reasoning skills be imparted onto students. I also believe it is important to establish these skills earlier in undergraduate students, instead of kicking the proverbial can towards graduate school. In ecological fields, quantitative reasoning is now essential in both applied and academic careers following undergraduate degrees. I have already seen success in students gaining interviews for jobs based on references I have written for them detailing their ability to learn to code and to evaluate data science problems. These tools are transferable to many jobs, even if coding is not explicitly involved, as critical thinking and problem-solving skills in recent graduates are attractive to employers.

I have found success in developing critical thinking through quantitative reasoning using mystery ecological datasets. These data sets are open source and tend to have a large breadth of coverage for a chosen ecological topic. Students are asked to explore these datasets both personally and in collaboration with other students to visualize and interpret what the data may show. Importantly, I alternate between exploratory and applied data sets so students can develop an appreciation for the usage of data science in a myriad of applications. I always try to emphasize this point to students, so they grasp how quantitative reasoning skills are applicable to many career paths. I also do not focus heavily on the use of statistics for several reasons. First, my courses do not have statistics pre-requisite, so I cannot assume all students have equal footing in statistical knowledge. Second, I believe a better workflow to build quantitative reasoning and critical thinking is to teach them first how to properly manipulate and visualize the data. Therefore, students have a clean data product for which they can apply their own knowledge, discuss among others and compare to other works. Without chasing some form of a significance value, I believe students have more freedom to digest and interpret data without bias.

The challenges I have with this approach largely deal with timing issues and class development as an early career academic (post-doctoral researcher and soon to be VAP). Currently, I am limited to developing quantitative reasoning in laboratory sections of courses. This severely limits the time available for students to learn enough coding skills to get started and to successfully work through enough datasets. Eventually, I would hope to develop a full “Data Science in Ecology” course, but it may be years before I have permission or freedom to do so. From previous iterations, I have learned that there is also a spectrum in the learning curve for undergraduate students to successfully work with ‘big data’. This makes it difficult to evaluate the pacing of assignments and the progression of data set complexity. Consequently, learning outcomes for myself and students often must be adjusted.

My goal for this workshop is to further refine my pedagogical approach to developing critical thinking in undergraduate students through practicing quantitative reasoning with ecological data. At various points throughout the semester I can often feel dejected about the slow progress of desired learning outcomes but also buoyed by the enthusiasm that some students develop for data science. Overall, I would like to utilize the resources offered through project Eddie and the vast knowledge of the educators present to bridge the gap between these two outcomes and to improve course development. Also, I am keenly interested in digesting what platforms other educators utilize to develop quantitative reasoning skills. As someone whose entire academic workflow is centered through coding in R, I find myself drifting farther and farther from using more commonly accessible tools (specifically Excel) when I teach upper level courses. This has been a frustrating and interesting challenge of how I, as an early career research, envision the tools that young scientists should be taught compared to more established colleagues.