Mid-point feedback/check-in

Please fill out a few post-it notes with:

Your excitement about teaching/using a module (yellow)

Your concerns about using/teaching a module (pink)

And then stick them on the poster board
So you want to teach a Macrosystems EDDIE module?

Lessons learned & tricks of the trade
Power, pitfalls, and potential for integrating computational literacy into undergraduate ecology courses

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Abstract
Environmental research requires understanding nonlinear ecological dynamics that interact across multiple spatial and temporal scales. The analysis of long-term and high-frequency sensor data combined with simulation modeling enables interpretation of complex ecological phenomena, and the computational skills needed to conduct these analyses are increasingly being integrated into graduate student training programs in ecology. Despite its importance, however, computational literacy—that is, the ability to harness the power of computer technologies to accomplish tasks—is rarely taught in undergraduate ecology classrooms, representing a major gap in training students to tackle complex environmental challenges. Through our experience developing undergraduate curricula in long-term and high-frequency data analysis and simulation modeling for two environmental science pedagogical initiatives, Project EDDIE (Environmental Data-Driven Inquiry and Exploration) and Macrosystems EDDIE, we have found that students often feel intimidated by compu-
Pitfall 1: Intimidation by computational tools

- Programming has a steep learning curve

Image: https://norcalbiostat.github.io/MATH130/01_intro.html
Pitfall 1: Intimidation by computational tools

- Programming has a steep learning curve
- BUT many students recognize the importance of knowing how to program— they just need help getting started

Data from Farrell & Carey 2018, *Ecology & Evolution*
Module activities assume no prior knowledge of R or programming
- Students modify and run ready-to-use scripts and models
- Modules break down complex activities into short, do-able chunks of code to reinforce developing skills

Use of real-world tasks makes programming relevant
- "I had very limited computer modeling experience prior to this activity. This was my first time truly modeling an ecosystem."

Patience and understanding is really important – the risk of failure seems very high
Faculty tester feedback:

"The module was really useful in engaging the students in an exercise using R without overwhelming them with details about how to actually write code. I think this was really helpful for the students who have never used R before to still feel like they were able to participate in the class exercise."

“I think that it is cool to introduce R to students in this way. It is much less intimidating than a completely blank slate and also gives students a taste for what is possible in R and any programming language.”
Pitfall 2: "Digital natives"?

- Despite ready access to technology tools, students' individual computing experiences vary dramatically.

"[my students] had essentially no coding (or, in some cases, computer) experience before attempting the module"
Solutions:

- Work with a partner to equalize experience levels

- Near-peer helpers → students who finish a section early can help fellow classmates

- Use worksheets and discussion questions to check-in and keep students engaged with the module materials
Student & faculty feedback:

"I enjoyed getting to fill in the worksheet along with using R so that way we had to understand the material, and not just plug in the code."

“My students had almost no experience with R or Excel but I am comfortable with both, so I was able to facilitate their use. The modules were very thoroughly prepared and with my experience as a regular R user, I was able to follow the workflow easily.”
Pitfall 3: Trouble with troubleshooting

- Many students lack experience troubleshooting software issues

- "App-ification" of day-to-day computing tools tends to hide error messages and underlying source code

https://xkcd.com/1024/
Solution:

- Detailed step-by-step troubleshooting, with screenshots from Windows and Mac operating systems, help students resolve problems on their own.

- Use of an on-campus computer lab can streamline troubleshooting, as instructors only have to juggle one type of operating system and version of R/Rstudio.

Error: Day 2451636 (2000-04-01) not found

When does it happen?
- `run_glm(sim_folder, verbose=TRUE)` will start the GLM run, but you will likely get an error similar to: “Day 2451636 (2000-04-01) not found”

Why?
- `time` column in .csv file not formatted correctly for GLM

How to fix it:
1. Open .csv file in Excel. Right click on the `time` column, then select Format.
Faculty tester feedback:

“Students were able to follow the instructions in the R script and complete the module. We used a computer lab with R and RStudio preloaded which helped facilitate using the module.”

“One group crashed the module towards the end… but we didn't have time to solve the issue. This type of thing is bound to happen and is awesome that it only happened to one pair! In the future, I'll have clean files on a flash drive to quickly replace.”
Pitfall 4: Are you also intimidated?

- Instructors may lack experience and comfort with advanced computational tools, like R

- Hard to troubleshoot if you don't know what you're doing!
Solution:

- Prepared assuming no prior faculty experience with GLM model, very limited exposure to R
  - Recommend faculty do a full run-through of module on their own so they know what students will encounter!

- Complete modules are ready-to-use 'as is' or modified by faculty
  - Pre-packaged lesson plan for instructors
  - Pre-class readings
  - In-class activities & datasets
  - Homework & answers

- Testing with faculty from range of institutions and experience levels
  - Catch areas that need more detailed explanations
Discussion: Excitement & Concerns
Next steps for EDDIE: More modules coming soon!

Macro-Scale Feedbacks

- How do local and regional processes amplify each other?
- Model carbon source/sink dynamics for different GLEON and NEON lakes using GLM

Macrosystems Synthesis

- How do cross-scale interactions, feedbacks, and teleconnections affect water temperatures globally?
- Analyze drivers of GLEON lakes’ water temperature using historical time series data

Photo: Cayelan Carey
Upcoming activities:

• Webinars (3):
  • Jan-Feb, about teaching with large datasets and how to use existing modules

• Workshops
  • June – Teaching with large datasets: barriers and solutions.
  • October – Designing your own classroom activities that use large datasets
  • Talk to Catherine O’Reilly this week to learn more!

projecteddie.org

Stay informed! Get periodic email updates by signing up.
Ready for Macrosystems EDDIE? Join us!

- We are seeking new faculty testers for Spring 2019 and beyond for Teleconnections and Cross-Scale Interactions
  → Want to try a module with your class and/or lab group? We would love to include you!

- Do you have a GLM-AED model calibrated for your lake? Would you be comfortable with us including it in the Macrosystems EDDIE modules? Let us know!