Teaching Notes

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Course Information
Department: **Biology**
Level: **Upper division undergraduate**
Course type: **Lecture with lab**
Students: **Biology, Environmental Science and Environmental Studies majors**
Number of Students: **16**

Module Information
Original Module Name: **Malawian Aquaculture Pond Ecosystem Challenge**
Files associated: Document (pdf) containing instructor information and student worksheet, powerpoint slides with background information and pre/post activity assessment.

Teaching Notes
These notes describe how I used the activity during my spring semester 2019 upper division majors General Ecology course.

I developed this activity while participating in the QUBES Faculty Mentoring Network partnership with SimBio in the spring 2019 semester. I was initially trying to develop a mini-case study to accompany the SimBio Ecosystem Ecology chapter that would only take 20-30 minutes of class time. As it is currently written, I found that completing the full activity in class takes more like 45 minutes. However, this activity is fairly flexible in its implementation. It could be done partially as a homework assignment, depending on the level of the students and the directions given in class. It could also be completed together as a whole class rather than giving students independent work time.

I incorporated this activity into a lecture on secondary production during the ecosystem ecology unit. My students prepared for lecture either by reading our textbook or by completing the SimBio Ecosystem Ecology chapter (for extra credit). Most students chose to complete the SimBio chapter. Our previous lecture was on primary production and during the lecture in which I used the activity, I first focused on comparing how energy and carbon move through ecosystems and then had students practice calculating trophic efficiency. The activity took the rest of the class period, so in the following lecture period I wrapped up our discussion by examining the simplified pond ecosystem from the point of view of the carbon cycle, in which arrows between pools represent actual fluxes rather than conversion efficiencies. This led to a discussion of the pools and fluxes that were initially missing from the ecosystem diagram (e.g. the atmosphere and respiration). Since the arrows in the ecosystem diagram now represented

production fluxes, I then asked the students how much biomass should be in each of the pools. That is, how much standing biomass of fish we would need to sustainably harvest at the maximal rate of production? This led to a discussion of the link between rates of production, life history and sustainable harvest of fisheries. I then transitioned into explaining how aquatic ecosystems can exhibit inverted biomass pyramids and we used an example from the aquaculture pond ecosystem to calculate residence times of carbon in each of the organismal pools and how this can create an inverted biomass pyramid. We finished by talking briefly about bioaccumulation and the possibility of biomagnification up this food chain.

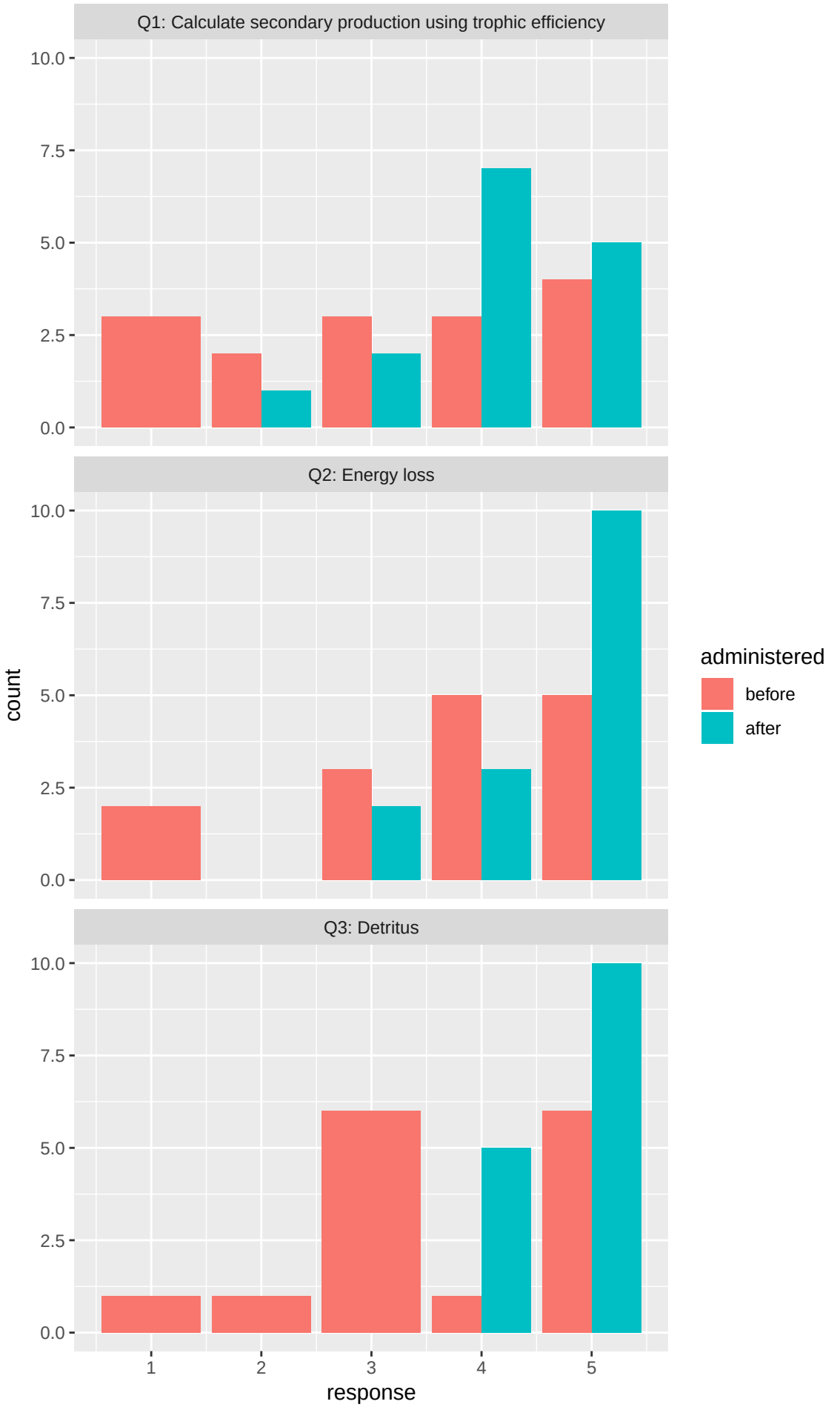
Preparation for the activity involved printing a double-sided instruction sheet for each student, printing out sets of ecosystem diagrams for students to choose from, and printing out feedback forms for students to complete before and after the activity. Implementing the case study took about 45 minutes. I think that this would have been plenty of time had I spent more time at the beginning walking the entire class through how to fill out a simple diagram (e.g the shrimp). I also found that some of my instructions on the student handout were unclear and have attempted to rectify that on the current version.

Student feedback during the activity indicated that they were initially very confused about what to do, but were able to figure it out after one-on-one instruction. Some students found the activity very straightforward and finished early. Although I provided additional challenge questions, the students who finished early were uninclined to do any additional work beyond filling out one version of the ecosystem diagram. To address this, the instructor may want to incentivise the challenge questions at the end in some way. Ways to do this could be to bring in an element of competition or, at the end, to require an oral report to the class or results written on the board from each group. I have provided places for students to write a response to reflection questions on the handout (I didn't originally do this), which may engage the faster students more at the end of the activity if it looks like they have more work to do.

Next time I will probably go over the shrimp example first with the whole class and then ask students to attempt to increase production, either by using a different species or by adding inputs to the shrimp ecosystem. I will ask each group to write their results on the board so that we can compare the percentage increase (or decrease) in production that each change elicited. I would also like to save more time at the end for a wrap up discussion.

A comparison of feedback forms administered directly before and after the activity indicated that the students felt like they improved in the stated learning objectives. See attached figure at the end of this document. Students were more likely to agree with the statements:
(1) I could calculate secondary production from primary production using trophic efficiency data.
(2) I could explain why secondary production is always less than primary production.

Students were also more likely to correctly agree with the statement:
(3) Detritus in ecosystems is primarily generated from unconsumed and unassimilated biomass.


Q1: Calculate secondary production using trophic efficiency
Q2: Energy loss
Q3: Detritus
count
10.0
7.5
5.0
2.5
0.0
1
2
3
4
5
response
administered
before
after