

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: **Mosquito Invasion! A Lotka-Volterra Competition Case Study**

Files associated: Powerpoint file containing instructor information, lecture slides, student worksheet and assessment form

Teaching Notes

These notes describe how I used the activity during my spring semester 2019 General Ecology course.

I developed this activity while participating in the QUBES Faculty Mentoring Network partnership with SimBio in the spring 2019 semester. I originally got the idea after reading about the Livdahl and Willey 1991 study in our textbook and decided to adapt the research paper into a case study that would allow students to practice interpreting Lotka-Volterra competition model parameters in the context of an applied ecological issue (e.g. invasive species). Although the study was rather old, I tried to make it relevant to my students by tying it to a more recent invasion of *Aedes* mosquitoes in California, where our school is located.

I was initially trying to develop a mini-case study that would only take 20-30 minutes of class time, but soon realized that if I really took the time to have the students practice all of my learning objectives, the activity could take upwards of one hour. My students had already been introduced to Lotka-Volterra competition models during a lab period in which they completed the SimBio Competition chapter as a graded lab exercise. During the class period in which I implemented the case study, I gave a brief lecture in which I (1) presented the definition of interspecific competition, (2) described how manipulative experiments are needed to “prove” competitive interactions, and then (3) reviewed the structure of the Lotka-Volterra competition model, focusing on defining the meaning of the parameters and the fact that this model is a phenomenological description of competitive dynamics between two populations that does not include any mechanisms. I then introduced the case study as a way that this model can be useful, even if it doesn't contain a specific mechanism for competition.

Preparation for the activity involved printing double-sided worksheets for each student and printing out feedback forms for students to complete before and after the activity. Implementing the case study took a little under an hour. I feel like I should have taken more time with the activity. Student feedback indicated that they felt they would have benefited from more time to think about and answer questions on their own. I also had to shorten the last section in which students discussed how the results of the study could inform management decisions for the emerging threat of invasive *Aedes* mosquitoes in California. Students' answers during this discussion demonstrated that most students were not able to make a data-driven argument for one strategy over another.

Next time I will probably omit the section where we examine how the model parameters cause the tire water model to predict competitive exclusion. This was particularly confusing to students and I ended up having to rush through it. Instead I may give them the the figures and have them practice graphing the tire water isoclines on their own. The original way I planned the activity may be appropriate for more advanced students, but my students were not ready for it.

A comparison of feedback forms administered directly before and after the activity indicated that the students felt like they were more comfortable with Lotka-Volterra models (see figure at the end of this document). Students were more likely to agree with the statements:

(1) I could explain what $\alpha_{12} = 0.3$ means.

(2) I know how to determine the outcome of competition from a phase plane diagram.

However both before and after the activity most students agreed with the statement: "changing species carrying capacities will change the outcome of competition", indicating that I failed to teach how changes in model parameters relate to changes in model equilibrium. Or, possibly students did not interpret this question in the way I intended.

