Teaching Notes

By **Demian A. Willette**

demian.willette@lmu.edu; Biology Department, Loyola Marymount University, Los Angeles, CA 90045

Course Information

Department: Biology

Level: Upper Undergraduate

Course type: Lecture
Students: Majors
Number of Students: 1

Number of Students: 14

Module Information

Original Module Name: The tale of two fish: A case study on vicariance and allopatric

speciation

Link to Original: N/A

Files associated: Mini-case study

Modification Learning Goals:

- Explore ways in which organisms can be differentiated into species and what are some advantages and disadvantages of various approaches.
- Relate how environmental and geological events can influence the evolutionary direction of two populations differently and can push them to form two distinct species.
- Analyze phylogenetic trees to understand what their structure tell us.
- Use multiple lines of evidences to reach a conclusion on what is a species.

Teaching Notes

This is a mini-case study style lecture activity developed while participating in SimBio's Faculty Mentoring Network and was initially designed to be used with the SimUText Chapter on Biogeography (http://simbio.com/products-college/simutext-ecology). The mini-case study is designed to be completed in approximately 30 minutes, however, this length may be extended if students are less familiar with the topics of biogeography, vicariance, speciation, and/or phylogenetics. Students unfamiliar with these topics (for example those who have not yet taken an upper division course on population genetics) would benefit from a complementary lecture on these topics, as well as a review of the SimUText Chapter on Biogeography. Alternatively, this mini-case study would be well suited for inclusion in such a course on population genetics.

This case study is based on real-world research on a novel study investigating the origin of a lake-confined sardine, the only member of the fish genus *Sardinella* occurring in a freshwater environment. This case study guides students through evidence that suggests the most likely sister species to the lake species *Sardinella tawilis*, the sister species being the marine fish *Sardinella hualiensis*. This conclusion is reached by examining morphological, meristic, and genetic data, yet is challenged by prevailing oceanographic and geographic features, including

the physical distance that separates current populations of these two species by hundreds of kilometers and a land barrier.

This mini-case study was developed for and used in an upper division biology course with 14 students (sophomore/junior standing) about 4 weeks into the semester and after a full lecture had be delivered on biogeography and the assignment of the associated SimUText chapter. Students worked in pairs and an introduction of the activity (the first page and half) were given as a pre-lecture reading assignment, then reviewed for ~5 minutes in the beginning of the class. Students were then given 30-45 minutes to complete the activity, with the instructor roaming the room to check in on student progress and ask guiding questions to advance the students' progress.

The students found the mini-case study very interesting, especially the students who had taken an independent initiative to read the related published literature on the topic (Willette et al. 2011, 2014). Note that pre-reading these two papers would provide the students with an advantage in completing the assignment (interpretation of the mini-case study originates from these published papers). I would not recommend assigning these papers as pre-reading, rather would encourage students to work through the mini-case study and possibly read the papers afterwards to strengthen clarity of the example.

In class observations and feedback provided by the students indicated that the mini-case study is a bit lengthy and is difficult to complete in the available 30-45 minute period. One adjustment would be to cut out one of the sections of the activity. Furthermore, students with strong familiarity with genetics, evolutionary concepts, and/or populations genetics found the assignment to be easier than those students not yet with that knowledge, even after participating in the aforementioned lectures and SimUText reading. This is an advanced topic and requires corresponding understanding of population genetics and concepts of evolution.

Instructor preparation for this activity should include a review of definitions used in the mini-case study (possibly as a quick reference list), having read the activity and included Instructor's Key, as well as the paper Willette et al 2014 on this specific example. Prep time would be approximately 45-60 minutes, primarily for reading.

This activity was part of my introduction to relationship between evolution and ecology, used as a building block to understand the intricate interaction between these sister field in the life sciences. Best of luck, and thank you!