Ecological Education: K–12

Ecology Education in Schools

Taste and smell are undervalued and underused in our school classrooms as teaching strategies. Tom Lauer presents here an innovative way of using taste to memorably demonstrate an ecological concept. Whilst his experiences are described at the college level, this activity can easily be applied to high school classes. Indeed, if you are looking for an extension activity for more able students, it provides an ideal motivating context. Have fun, but do remember to check school policy on providing food items, and of course allergies to peanuts, dairy, etc.

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Eating Your Way Through Ecology Class: It's a Realistic Way to Learn.

Introduction

While attending graduation, I ask one of my students what was the most significant classroom experience she had while attending our university. Much to my astonishment, she indicated a day 2 1/2 years prior in my ecology class, when I had students eating Hershey Kisses to demonstrate an ecological concept. As educators, we often use sight and sound in the classroom, but ignore other senses that can be used for learning. With the exception of culinary schools, taste is generally ignored as a pedagogy tool. Why? I suspect that the additional effort to have safe, acceptable, low-cost foods available to students is one contributing factor. Another, and more likely deterrent, is understanding how to incorporate taste into the classroom experience, even for motivated instructors.

The concept of taste is closely associated with predation and can be used as a teaching tool (Lauer 2000). We know that taste will discourage consumption and is a defense mechanism for some organisms (Molles 2002). We also know that if a prey item is available (Forrester and Steele 2004, Graeb et al. 2004), acceptable to the taste (Stanger-Hall 2001, Massei et al. 2003, Darmaillacq et al. 2004), and can be physically consumed (Truemper and Lauer 2005), it is more likely to be eaten. In addition, students (like many predators) are usually hungry and can be counted on to eat most anytime. Lastly, the National Science Education Standards (National Research Council 1996) suggest that active learning provides a lasting effect to the student in contrast to passive classroom activities. Applying and combining these concepts in the educational setting serves several purposes: (1) taste can be used as a learning tool, (2) taste can teach ecological princi-

TABLE 1. Mock data set and calculations showing how to conduct the analysis.

Trial/student	No. of kisses in population (abundance)	Search time (s)	Handling time (s)	Total time, TT (s)	Rate of kiss consumption (1)/TT × 1000
1	2	35	9	44	23
1	5	24	8	32	31
1	10	10	12	22	46
1	20	7	11	18	55
1	50	3	13	16	62
2	2	26	12	38	26
2	5	23	11	34	29
2	10	11	9	20	50
2	20	4	8	12	62
2	50	3	12	15	67

ples, and (3) taste can enhance the student experience.

Moving from concept to application in the classroom is not always obvious to instructors. An approach I often use is to generate data as they relate to the concept at hand. For example, I often try and replicate existing data sets (typically from the textbook) to validate or dispute findings. This methodology provides an opportunity for students to critically evaluate scientific findings that is often lacking in a "lecture only" setting. An example of this teaching application involving taste is delineated below, and involves a specific ecological predator/prey principle.

Teaching objective: predator–prey interactions

To have students understand two components of predation, search time and handling time, and how they interact with varying abundance of prey. The specific concept has also been termed "Type II Functional Response" (Holling 1959).

Methods

1) Prior to class, obtain a bag of Hershey's Kisses, and ~100 –200 other similar-sized candies wrapped in paper, foil, etc.

2) During class ask for volunteers to participate in the exercise. If you think getting volunteers during class will be problematic, you can ask selected students to participate before class begins. Two students are required to time activities, while one or more are needed to act as predators.

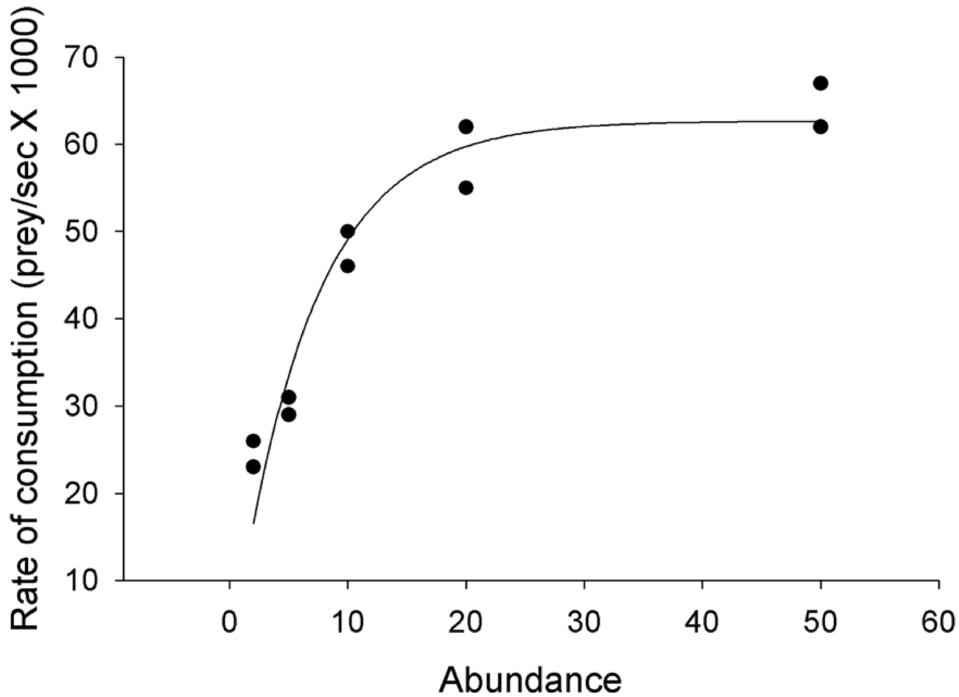

FIG. 1. Mock data set points plotted with a curvilinear best fit line demonstrating a Type II functional response, after Holling (1959).

3) Spread out the similar-sized candies on a large desk or the floor. Do not put any kisses with them at this time.

4) Show the predator the candies that are spread out. Explain that you will be putting some Hershey's Kisses in with the other candies, and indicate that the kisses are the only are the kind of food they can eat. Their task is to locate a kiss, unwrap, and eat it when they are given the signal to do so. When the kiss is completely swallowed, the student needs to indicate he/she is done.

5) Blindfold the student.

6) Place two kisses among the other candies.

7) Give the "Go" signal to the student to begin the search.

8) The time required to locate the kiss should be recorded by one timer. The time required to unwrap and eat should be recorded by the other timer.

9) After the first kiss has been eaten, have the student do the procedure four more times. However, with successive trials, increase the number of kisses in the candy community to 5, 10, 20, and finally 50, but only have the student eat (and time) the first kiss found. Record the data for the class to see (e.g., on a chalkboard, see Table 1). By having multiple students participate (separately) in the five trials, several things will occur. First, more students are involved in the learning process. Second, some measure of variability or increased number of data points will improve the quality of the data, and third, the number of students participating can vary depending on the time available.

10) After the data have been collected, plot the results on a graph. The *X* axis should be prey abundance (1, 5, 10, 20, and 50), while the *Y* axis should be

the rate of consumption expressed as kiss (1)/second consumed, using total consumption time (searching and handling). The theoretical relationship is shown in Fig. 1.

Concept application

Ask the students in the class to explain the graph. Include in the questioning any changes in both search time and handling time as the abundance increased. Theoretically, search time is reduced, while handling time remains the same. The ecological concept suggests that as prey increases from low levels, the number of prey consumed increases rapidly. However, as prey density reaches higher levels, further increases in the rate of prey consumed is slowed asymptotically by the amount of time needed to "handle" (kill and eat) the prey. Next, have students speculate whether this concept applies to other predators, such as bears eating salmon, birds eating worms, wolves eating moose, and deer eating plants. Lastly, have the students come up with other predator–prey examples that may fit the concept, including searching the Internet for pertinent sites (key words: ecology; functional response; numerical response; population ecology; quantitative ecology; predator–prey functional response).

Term introduction

After the discussion, I usually give the "lecture" on the three types of functional response curves (Fig. 2). When the introduction of terms follows the understanding of the concept (i.e., nonverbal awareness [Hendrix 1960]), students are less likely to be exposed to "jargon fright," and assimilate the concept more easily.

Conclusion

The teaching of the three types of functional response has merit in the ecology classroom, particularly when the students are actively involved in the learning process. However, the greater importance of this activity may be in identifying a pedagogical technique that links an ecological concept to student learning. Although we don't usually think of students as predators while giving instruction, employing them in this role has merit (Lauer 2000, 2003), and can be used as a template for parallel learning experiences.

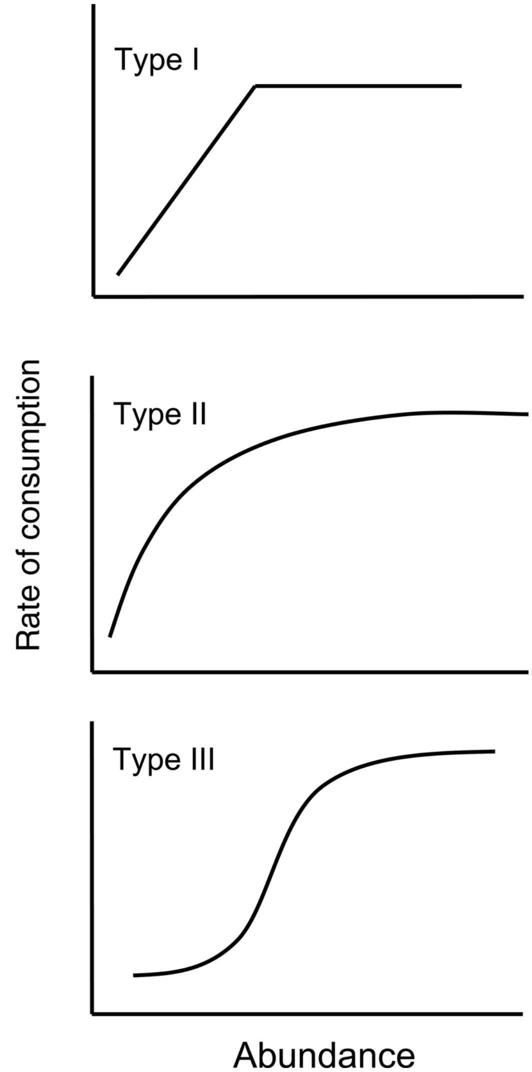

Fig. 2. Theoretical Types I, II, and III functional response relationships patterned after Holling (1959). Type I response: As prey increases the number of prey consumed increases proportionally until predators are satiated. Type II response: As prey increases from low levels, the number of prey consumed increases rapidly. However, as prey density reaches higher levels, further increases in the number of prey consumed is slowed by the amount of time needed to "handle" (kill and eat) the prey. Type III response: As a previously rare or unknown prey species increases, predators slowly increase their consumption of that prey at first, then rapidly increase their consumption with prey density, until limited by predator satiation or prey handling time.

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