

Class project inspires research article in *Ecology*

By David Malmquist

(April 9, 2013) A study that began as a class project among graduate students at the Virginia Institute of Marine Science is now a peer-reviewed research article in *Ecology*, the flagship journal of the Ecological Society of America.

The article, “Physiological effects of diet mixing on consumer fitness: a meta-analysis,” is co-authored by VIMS graduate students Jonathan Lefcheck, Matt Whalen, Theresa Davenport, and Josh Stone, along with VIMS Professor J. Emmett Duffy.

Duffy teaches the Evolutionary Ecology course that inspired the students to pursue their research question: whether it’s better for an animal to have a mixed diet or instead stick to a single favorite prey item.

“Emmett initially proposed the question in class,” says Lefcheck, “so we all consulted the literature and wrote a report. When he invited us to continue the project after the class, four of us decided there was more meat to this, so we ran with it. It took us a year, but we finally managed to perform all the analyses. It shows the work produced in your classes can actually impact the field. It’s a neat illustration of students going after a question that they find interesting but that isn’t necessarily directly related to their dissertation research.”

Duffy and the students agree that the project was a uniquely valuable alternative to conventional lecture classes. “They conducted research and followed it all the way through to publication,” says Duffy, “learning by experience how to deal with many of the same challenges as research scientists.”

The team’s “meta-analysis” required close reading of 161 published research articles describing 493 experimental manipulations of prey diversity. The animals in the chosen studies were of many kinds, from butterflies and beetles to oysters and clams. One study even looked at a parasitic plant. The experiments—most in laboratory settings—included organisms from marine, freshwater, and terrestrial habitats, and, in addition to herbivores and carnivores, incorporated omnivores, detritivores, and parasites.

The team’s goal was to use the results of these 161 studies to test whether a mixed diet enhances an animal’s “fitness,” as defined by measures of growth, reproduction, survival, and population increase or population size.

“Specialization versus generalism is an essential issue in ecology,” says Lefcheck. “It’s been studied for a long time but many questions remain.” These include the benefits of dietary specialism versus generalism, the factors that promote each strategy, and the impacts each has on a food web.



Amphipods like this were one of the animals used in experimental manipulations of prey diversity. Photo by Matt Whalen.

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Virginia Institute of Marine Science
School of Marine Science
College of William and Mary
Gloucester Point, VA 23062
(804) 684-7000

Lefcheck says that ecologists originally thought of specialists—think an anteater—as more fit than generalists—think a blue crab—because specialists have identified a single food item that maximizes all of their requirements for energy and nutrients, and are likely to have evolved physical features and behaviors needed to capture and digest that one item.

“But,” he adds, “when scientists turned to nature, they found a high prevalence of generalism. So the question is—why do so many generalists persist in the real world?”

Lefcheck explains the issue further by analogy with human consumption of pizza. He asks “Why would we expect a generalist’s diet of pizza—combining bread, cheese, vegetables, and pepperoni—to be better than a specialist’s diet of pepperoni only? Is it because eating the whole pizza provides a more balanced diet, or perhaps prevents the build-up of toxins, say from spoiled meat? The field of foraging ecology has formally proposed several hypotheses to answer these questions. The goal of our study was to evaluate the evidence for two—the balanced-diet hypothesis and the toxin-dilution hypothesis.”

The results of their study show that on average, animals do better on mixed diets than on the average of single-species diets, but not as well as when they eat the best single prey species.

“The evidence for the nutritional benefits of diet mixing is pretty weak,” says Lefcheck. “That suggests that diet generalism isn’t strongly favored by the inherent physiological benefits of mixing food types, but is more likely driven by ecological and environmental influences on consumer foraging.”

Duffy adds, “To our surprise, getting balanced nutrition seems rarely to be the reason that animals eat a variety of foods. Instead, generalized diets probably have other benefits. Being less picky gives you more food and more flexibility, like being able to feed in safe places where there’s less risk of getting eaten yourself.”

In other words, how you get your pizza—whether made from scratch, warmed from frozen, taken out, or ordered in—may be more important to your health than whether you eat all the ingredients or just pick out your favorite topping.



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