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Connecting Rodents to Our Roots: A Journey into Education and Outreach

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Research Article

Connecting Rodents to Our Roots: A Journey into Education and Outreach

—Samm Azen

There's nothing quite like watching a group of adults and children scurrying across a damp, leaf-littered forest floor, acting like mice, voles, and chipmunks so that they can learn about a little-known yet vital ecological niche. Yet that is just what I did while conducting an outreach program to share my research on the effects that rodents have on their environment. As an outdoor education major, my goal was to teach these people about the importance of rodents to forest health. Outreach is an important step in actualizing real-world action after research reveals an important issue. This article describes my experience developing an outreach program based on research I performed over the course of a summer. In its own way, this article serves as outreach on the topic of creating an outreach program.

Baseline Information

If I were to ask anyone on the street about how rodents affect the world, they would most likely think about having mice in their house and become squeamish. Although typically considered pests, rodents are actually quite important for the health of the forests they live in, for reasons beyond the limits of human eyes.

The author in the woods of northern New Hampshire.

There are fungi that live underground and colonize the roots of trees, helping the trees collect water and nutrients in exchange for carbohydrates. These fungi, known as mycorrhizal fungi, help trees grow and to resist drought and other disturbances. They help trees so much that a tree that has outcompeted its neighbors for sunlight but has not been colonized by mycorrhizal fungi will not grow as large as trees that get less sunlight but are colonized by fungi. The problem for mycorrhizal fungi is that they live underground so they cannot get their spores to spread through wind and water, like aboveground mushrooms and plants can do. That's where rodents come in.

Rodents can smell the fruiting bodies of these fungi—known as truffles—and they like to eat them. After the rodents eat the truffles, they carry the truffle spores around in their guts for some time

before depositing them elsewhere in their scat. Without rodents, mycorrhizal fungi would not be able to effectively reproduce and spread to the trees that need them.

Through my field research, which was funded by a Summer Undergraduate Research Fellowship (SURF) and performed with members of a natural resources research lab headed by Dr. Rebecca Rowe, I observed the movement and diet patterns of seven rodent species at the Dartmouth College Woodland, known as the Second College Grant in northern New Hampshire. A PhD student, a fellow undergrad, and I set webs of live traps extending from the center of a disturbed and regenerating section of the woods out into an established, wooded area. By marking and recapturing small mammals, we were able to record their movement between old-forest and growing-forest areas. By coupling those data with analysis of scat samples from the traps, we were able to show that rodents carried truffle spores from the established woods, which were able to thrive thanks to their fungi, into the regenerating sections, which needed to establish relationships with the fungi to grow and thrive.

One of the twelve forest clear-cuts studied by the author. *Photo by Ryan Stephens.*

This experience showed me the important impact that rodents have on forest communities, and I wanted to share this knowledge so that people would be less likely to kill these animals by setting traps and hiring exterminators, and would do their part to promote their well-being for the sake of forest communities at large. If I could reach out to people and make them understand the issues in a way that felt fun, interesting, and important, I knew that they would be inspired to keep learning more about the topic and spread the word to others.

To extend my summer field research, I created an outreach program. As an outdoor education major, I was prepared to create an experiential educational program that could inform participants, no matter their age, without it feeling too much like a lecture, allowing them to leave feeling energized to do something with the information they had just learned. With the help of Ryan Stephens, the PhD student with whom I worked all summer, I created a lesson plan, came up with a few activities, and invented a new game that represented what I wanted to teach. Next I partnered with a local environmental education facility, White Pine Programs, to pilot the outreach program on their beautiful forested campus in York, Maine.

Getting the Word Out

Educational outreach is a way to inform community members about the existence and importance of locally relevant topics, outline for them the overall situation, and show them how they can help. Once a person or group has decided that it is important to educate the public about a specific issue, it is necessary to distill that issue down to a central objective. The objective is the most important element of an outreach program, because it is essentially the program's thesis statement; it is the one or two informational sentences that the participants should leave with and want to share with

their friends. In my case, my objective was to show that rodents are integral to the health of the forest because they disperse important truffle spores.

Once an objective has been determined, every word, slide, and activity should support that purpose in some way, just as a thesis should be supported by an essay. The basic structure that I have developed for a three-hour outreach program looks like this:

1. Introduction to topic, instructors, and instructors' expertise on the topic.
2. Overview of the program and schedule.
3. Short activity related to the topic to loosen everyone up.
4. Supplementary information to create a strong basis of knowledge about the subject.
5. Longer activity or game that represents the situation of the topic.
6. Debriefing of the activity to underline what can be learned from it.
7. Secondary activity that continues to teach in an experiential manner.
8. Debrief again.
9. Wind down, summary of the program, chance for questions from participants.
10. Goodbyes.

It's important to note that there are not long periods of talking anywhere within this structure. For the most part, the activities should be designed to make a point, and it should take minimal effort from the facilitator to drive those points home once the game has been played. The debriefing should involve questions formulated to bring out the answers that the participants subconsciously formed while playing the game. This is easier than it sounds if the game is good.

The Program

On the day of the program, twelve people had signed up, which was a perfect number, because it is enough people to stimulate thoughtful conversation but not so large that people get lost in the crowd. The participants were mostly families, consisting of children as young as four and adults up to sixty-three years old.

My introduction to this group was no longer than the baseline information section of this article. After talking briefly, I passed around taxidermied samples of deer mice, red-backed voles, and chipmunks—all local rodents—so that everyone could touch and see them. This made the topic a little more real for the participants, grounding it in the physicality of the animals and their evolutionary adaptations for finding and digging up truffles. These adaptations include shorter tails, smaller eyes, slicker fur, and bigger feet on the burrowing red-backed vole versus longer tails, larger eyes, and slenderer yet longer feet on the agile deer mouse. After talking a little more about the animals, I brought everyone out to play the game I had invented.

The Game

The intention of the game was to show experientially how a diversity of rodents is important for any given forest. Diversity is important because different rodents vary in how much of their diet is made up of truffles and therefore how much their actions can help provide trees with these critical spores, as well as which spores are dispersed and where. To do this, I had to show the direct impact that rodents have on their environments, how different species of rodent affect their ecosystems differently, and the difference between the presence of one rodent species and the presence of multiple species. The game and its rules therefore had to reflect those goals.

These truffles dug up in Bartlett Experimental Forest (NH), are similar to those found at White Pine Programs in York, Maine. *Photo by Ryan Stephens.*

First, because the subject was the movement of rodents throughout the forest and their effects on truffles, I decided to play the game in the forest and assign the participants roles as different types of rodents. Their goal was to collect different types of truffles, which were represented by different types of candy. At the end of the game, we rolled dice to see what sort of disturbance hit our forest—flood, drought, or fire—all of which would negatively impact the health of the forest. If the participants had collected enough candy/truffles to protect the trees from these disturbances (based on an arbitrary limit we established ahead of time), the forest would survive. If not, some trees would die. In the case of the game, that meant that depending on which disturbance took place, we removed a certain amount of the candy the participants had collected.

To show the importance of diversity, each species of rodent-participant had different rules about how they could move around the woods and collect truffles. I devised these rules based on my observations during my SURF field research. Since the game is supposed to be fun, I added in some incentives for urgency with a time limit and a hawk—played by Ryan—that could tag rodents and make them go back to home base.

When it was time to begin, I brought the participants into the woods and showed them the boundaries of the area in which they would be playing. I told them the basic premise of the game and showed them the four different buckets with four different types of candy placed around the perimeter. I then assigned them all to be mice, because the only section of woods that I observed during my research to be monopolized by one species of rodent was largely populated by deer mice. Our research showed that mice ate truffles but did not prefer them over seeds and were good at avoiding predators. Therefore, in my game the mouse-participants could speed walk but grab only one piece of candy per trip and had to get two seeds (represented by hard candy) before they could take one truffle (represented by chocolate candy). At the end of this round, there were predictably more seeds in the community pot than truffles.

When we rolled the dice, our forest was hit by fire. Trees were protected from fire by truffles represented by chocolate candy, so if there were enough chocolates, the forest would survive. This reflected the truffles' ability to provide extra water to protect against fire and extra nutrients to regrow from the ash. Unfortunately, there were fewer chocolates than the arbitrary limit we had established earlier, so much of the forest and truffles were wiped out, meaning that the rodents would have to work hard to repopulate the area in the next round.

A southern red-backed vole. *Photo by Ryan Stephens.*

For the next round, I added in the bumbling red-backed vole, a picky eater who eats fungi almost exclusively. The participants assigned to be voles could collect two truffles per trip and did not have to collect seeds but had to hop everywhere. I also added in the larger chipmunk, who could carry two truffles per trip but had to walk at a normal pace. Because the chipmunk is larger than the other rodents and is active primarily during the day, it was more likely to be pursued by the hawk. Again, these rules were based on observations that I had made during my summer field research. With a healthy mix of mice, voles, and chipmunks to collect different truffles at different rates and be pursued by predators differently, the result was many more truffles in the community pot.

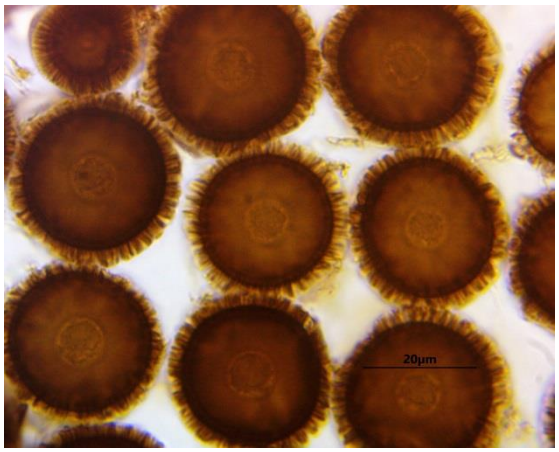
After rolling the dice to see whether the forest would face the disturbance of drought, flood, fire, or deforestation, we were hit with drought. This time, however, the number of truffles was far more abundant and the forest could survive. This second round of the game was shown to hold up to any disturbance better than the first round, and because the forest survived, the participants could munch happily on their pile of candy.

As they noshed, I led a debriefing in which we discussed the results of the game. The key questions that I asked were "What happened?" "What was different about the two rounds and why?" and "How does this relate to real life?" By going over the events of the game and connecting them to real life, the participants gained an understanding of the purpose of the game and the ideas behind the program. Despite the fact that the participants were having fun running around the forest and collecting candy that they later got to eat, they were easily able to visualize and synthesize the importance of a diverse community of rodents in a forest.

The Reinforcing Activity: Truffle Hunting

At this point in my outreach program, the group members had become comfortable with each other, the instructors, and the topic. They had also been active, played a game, and gained a deeper understanding of the topic. The next step was to ground the information in a contextual activity that would bring the information from a high-up, abstract idea down to an on-the-ground reality in our backyard.

To do this, we followed the evidence of rodent activity in the woods—rodent-sized holes that terminated in the shape of a truffle—and then dug there ourselves to find more truffles in the same area. Ryan and I had scouted out areas with good signs of rodent activity the day before, so we knew where to go and where to show the participants to dig, leading to a successful harvest during which every participant, young and old, found at least one truffle. After congratulating ourselves for thinking like rodents so effectively, we went back to White Pine headquarters to look at some spores under a microscope, talk about how people can help the well-being of these rodents, and field some questions.



Microscopic spores of a truffle in the genus *Elaphomyces*. *Photo by Ryan Stephens.*

Based on the quality of thoughtful questions that were asked and the full understanding of the topic that the group seemed to have, it was a successful day. Adults and children alike were able to discuss the importance of the topic and how they could take action, such as using Havahart live traps and relocation away from homes instead of exterminators, and managing wooded areas to allow for good rodent habitat. My objective, which was to show that rodents are integral to the health of the forest because they disperse important truffle spores, was a success. Participants learned the baseline information, gained an understanding of the concept, found real proof of its occurrence that they could hold in their hands, and were then able to talk about it all in their own words. This is how I could measure the success of the program.

Final Debriefing

Outreach is an integral next step after research. Once it is understood that a topic is important, it is equally important to make sure people understand the topic and how to take action about it. Performing my SURF research and using it to design an outreach program was a novel, incredibly strenuous, and undeniably rewarding experience for me. I was able to experientially educate myself on the process of discovering new knowledge, synthesizing it into something everybody can understand, and delivering it in a way that everybody can enjoy. A monumental effort from multiple people went into the completion of this project, and sometimes it seemed like it would not happen when there were problems with research timeline completion and game development. I pushed forward because I knew it was important, and in the end, it was absolutely worth it to know that I was helping to make a positive impact on the world.

Fun, friendly, and educational outreach programs are the key to making sure interested community members can start important conversations and become motivated to change a part of their behavior to reflect what they have learned and what they feel is important. Because of this experience, I will graduate and step out into the world as an environmental educator and consultant ready to educate

communities about how to make the world a better place. I will help communities engage with the world around them and effect change in ways that are important to them.

I could not have done this research project and outreach program without the help of all the wonderful people who supported me throughout the entire process. Thank you to Dana Hamel for your support through the Summer Undergraduate Research Fellowship as well as the Hamel Center for Undergraduate Research staff, including Peter Akerman and Molly Doyle. Finally, thank you to my mentors, Dr. Rebecca Rowe and Dr. Ryan Stephens. Each of you have shoulders on which I have stood to accomplish my goals; I am incredibly grateful for all of your support.

Author and Mentor Bios

Samm Azen, from Philadelphia, Pennsylvania, is majoring in outdoor education, with a minor in environmental conservation and sustainability. He will graduate with a bachelor of science degree in May 2019. Samm applied for a Summer Undergraduate Research Fellowship (SURF) because he was interested in learning about what goes into researching a little-known ecological niche, in this case, the role of small mammals in forest regeneration. He values learning how every species is important in an ecosystem and wanted to learn how to share that understanding with others. Samm notes that his project provided great practice in setting specific, achievable goals and reaching them on time through hard work. “This project helped to show me what goes into research and helped me get better about talking about specific environmental issues.” Samm plans to work as an environmental activist and hopes that his Inquiry article will “get the word out about getting the word out, because many scientific communities lack the ability to get information to laypeople.”

Rebecca Rowe, an associate professor in the Department of Natural Resources and the Environment at the University of New Hampshire (UNH), specializes in researching the population and community dynamics of small mammals across space and over time. Samm began working in Dr. Rowe’s lab after taking a class on conservation biology. Through this work, he became fascinated with the role of small mammals in forest ecosystems. Dr. Rowe says she was thrilled that Samm, an outdoor education major, decided to conduct scientific research in the field, with the goal of sharing what he learned through an educational outreach program. She hopes more students will connect the two fields of outdoor education and ecology, as Samm did. She witnessed his growth in understanding scientific research at the same time as he helped his research partner, PhD student Ryan Stephens, learn about community education. Dr. Rowe went with her son to Samm and Ryan’s outreach program, and she commends them for their ability to engage the attendees with lively games and discussions while also communicating their science to a general audience.