

How personalities of wild small mammals affect forest structure

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Credit: Holland Haverkamp

A mouse scampers through the forest, stopping suddenly at the sight of a tree seed on the ground. A potential meal. And a dilemma.

The mouse must decide if it should eat the [seed](#) immediately. Or hide it in a safe place for consumption when food is scarce. Or pass it up in

hopes of something better.

Many factors determine what the mouse will do next, including how abundant the seeds are and if the rodent is a fan of that variety.

Personality is another element that might play a role in what the mouse decides, according to a University of Maine researcher.

How animals react to an environment that is transforming due to [human behavior](#) and [climate change](#) is at the core of research being conducted by Alessio Mortelliti, an assistant professor of wildlife habitat ecology at UMaine.

One study Mortelliti and his students are pursuing focuses on how individual personalities of small mammals affect their response to global change.

Like humans, animals have a personality, according to Mortelliti.

"Anyone that has a pet knows they have a personality," he says. "It's the same for squirrels, mice and voles."

Within a species, individuals can be aggressive or shy, more or less social, Mortelliti explains.

"We're looking at how this individuality—their own way of being—affects the way they respond to changes in their environment made by humans," he says of wild small mammals.

When a mouse finds a seed, the decision it makes affects more than the mouse. If the seed is eaten immediately, any chance of a plant sprouting from that seed is gone. If the mouse decides to move and store the seed, a plant has a chance to grow.

Mortelliti believes that by modifying the environment, humans may be favoring certain personality types over others and, in turn, altering the course of evolution and the shape of the forest.

"By changing the proportion of different personalities in a population, we're changing the capability of that population to react to future changes in the environment," he says.

In the same way that a human's personality affects his or her professional success, an animal's personality affects its chance of survival, according to Mortelliti.

To test his theory, Mortelliti and his students set up a study in the Penobscot Experimental Forest in Bradley and Eddington, Maine. For five months each year, the researchers capture and tag mammals and measure their personalities using tests to determine how shy, aggressive or active they are. The animals are then tested several more times to see which are at more of an advantage in their environment—the wallflowers or the risk-takers.

Personality refers to individual-level differences in behavior that are consistent over time, says Allison Brehm, a UMaine master's student in wildlife ecology who is on the research team, helping evaluate behavior by conducting tests that look at traits such as boldness, activity, exploration and docility.

For the main personality test, the researchers catch the animal in the field and place it in a white box with a square marked in the center. Software is used to track the animal and determine how much time is spent moving around, staying in the corner or venturing into the middle. The test measures the tendency of an animal to emerge from a safe or enclosed area to enter a more exposed or risky space.

"We found if a mouse was really curious and went around and crossed the center, it tends to do the same thing months later," Mortelliti says. "That shows it's really their own personality. It's not their mood of the day. That's how they act."

Mortelliti compares the repeat behavior to humans. A shy person, for example, behaves in a relatively shy manner consistently, he says.

"From a perspective of a mouse, vole or a squirrel, you're scared, you're being put in a new environment, you will think twice before going in the center," he says. "It's like going to a party, getting in the center and dancing. You have to be brave to do such a thing. It's exactly the same for a mouse, but some individuals do it."

Since the start of the project about two years ago, the researchers have tagged around 1,500 mice, voles, shrews, squirrels and chipmunks.

The researchers are measuring personality traits and have found variations within each species. Although they haven't yet quantified the results, they have observed disparities between species and plan to compare differences in personality.

Another aspect of the project relates to how individuals with different personality types make decisions in front of seeds and how those decisions affect the composition of Maine's forests.

"Small mammals exist to predate or disperse seeds; that's their job in the ecosystem," Mortelliti says. "The whole life of a plant is about trying to use the service of rodents as much as possible."



Allison Brehm, a master's student in wildlife ecology whose research paper was recently accepted in the international journal *Animal Behaviour*, evaluates small mammal behavior in the Penobscot Experimental Forest. One aspect of the project relates to how individuals with different personality types make decisions about seeds. Credit: Holland Haverkamp

What a mouse or other small mammal decides to do when it encounters a seed links back to personality, according to Mortelliti, who says he believes this is the first study looking at personality and seed dispersal.

For one of the experiments, microchipped animals are presented with artificial seeds. The seeds are flagged and tracked to determine if they were eaten immediately or cached.

"Spending a summer crawling around the forest looking for small mammal caches teaches you a lot about the way these animals think—and I learned to see the forest a bit differently," says Brehm of Pembroke, New Hampshire.

When the animal passes under an antenna, the researchers can tell who the animal is and its personality based on previous tests. The researchers also observe the decisions that are made in front of the fake seeds.

When it comes to real seeds, Mortelliti and his students have found the animals don't care for paper birch or balsam fir, which may explain why these are the most common trees in the Penobscot Experimental Forest. The animals seem to prefer spruce and white pine.

"What we're looking at specifically—on top of what they like and what they don't like—is how different individuals act in front of seeds," Mortelliti says. "Does a risk-taker tend to hide more seeds? How does a shy individual act? Which individual will behave differently in front of a seed?"

Sara Boone, another graduate student who is working on the project, says the personality of a small mammal may influence its behavior in different situations.

"Bolder individuals may be more willing to take risks to find seeds than shy individuals, or choose seeds based on different nutrient contents or sizes. Shy individuals may consume fewer seeds overall than bolder individuals, and have less of an impact on seedling recruitment," says Boone of Greenfield, Wisconsin, who is pursuing a master's degree in

wildlife ecology.

The project marks Boone's first time delving into personalities while studying animal behavior. She is interested in the community dynamics of research sites and how the personality and behavior of small mammals influence community structure.

"If humans are modifying the environment, they're modifying the composition of personality within a population, then this, in turn, will have effects on the forest, because we're favoring certain individuals which make certain decisions in front of seeds," Mortelliti says. "If we're favoring personalities that are going to predate more than cache, then this will have an effect on how forests regenerate."

Understanding how individual animals and populations are affected by global change is important, Brehm says, especially in a state such as Maine, which represents either the northern or southern edge of the range of many species.

"If [land-use change](#) gives an advantage to individuals with certain personality types—for example, the bold ones—over time, populations experiencing these changes will be less behaviorally heterogeneous, and ultimately less resistant to [global change](#)," she says.



For one of the experiments, microchipped animals are presented with artificial seeds, right, that are flagged and tracked. Credit: Holland Haverkamp

While personality has a genetic component, nature also has promoted its existence, according to Mortelliti.

"If it wasn't useful for us to have personalities, we wouldn't have this variation in individuals," he says. "Natural selection has made sure that within a population we have diversity of behavior. If natural selection

has promoted variation in personality through millions of years of evolution, that suggests this variation is important for species and ecosystems."

If through land-use change, certain personalities in a species population become homogenized, the capability of populations to adapt will become affected, Mortelliti says. In the long term, species need variation in personality to preserve their evolutionary potential, he adds.

"In some years and circumstances certain personalities might be advantaged, versus in others when other [personality](#) types might be advantaged. But for a species to be able to face environmental challenges of the future, this richness and variation in behaviors has to be maintained," he says. "If land use affects different personalities, then we might be modifying the evolutionary potential of populations."

In another project, Mortelliti is studying how small mammals may affect the range expansion of plants due to climate change in Acadia National Park.

In April 2017, Mortelliti was one of three scientists awarded a fellowship to conduct research in Acadia. The fellowships were granted as part of Second Century Stewardship, an initiative of the National Park Service, Schoodic Institute at Acadia National Park, and the American Association for the Advancement of Science (AAAS).

Over the last 100 years, Acadia's forest composition has transformed due to climate change, according to Mortelliti.

"In the next 100 years, it will change completely again," he says. "The whole plant community is going to change because it's really on the border of the distribution range of many plants."

By favoring certain plant seeds over others, small mammals will shape the forest composition, Mortelliti says.

"As these plants move northward, rodents are going to be critical, they're going to be the gatekeepers of Acadia National Park," he says.

To help plan for the future forest landscape, Mortelliti and his students collected about 20 different seeds of plants that are expected to invade Acadia in the next 10–20 years. The researchers are evaluating which types the small mammals prefer, and which ones they don't.

"We want to identify the winners and the losers," he says. "Which are the plants that are going to be favored by rodents, which are the ones that are going to be blocked?"



University of Maine students, from left, Sara Boone, Allison Brehm and Noah Baskin walk through the Penobscot Experimental Forest to track, tag and

evaluate mice, voles, shrews, squirrels and chipmunks. The researchers are measuring a variety of personality traits such as boldness, activity, exploration and docility. Credit: Holland Haverkamp

The goal is to provide Acadia with a list of the types of plants it can expect in the future.

"The results of our field experiments will allow managers to predict how local forest communities might change in the coming years and allow them to take the appropriate actions in time," Mortelliti says.

In Acadia, just like any other forest, small mammals have the biggest effect on which plant species are more dominant, and researchers have often ignored this, according to Mortelliti.

Research has shown that small mammals can consume and/or remove up to 95 percent of the seeds available in their given territory, Brehm says. It's important, she adds, to shed some light on this process, especially in a state that relies so heavily on the forest industry.

"In Maine, forests and forest products play a major role in the economy. Maine is the most forested state in the U.S., and 97 percent of the forest area in Maine is subject to natural regeneration," she says. "Because small mammals play a fundamental role in the process of forest regeneration, understanding the impact they can have on the structure and species composition of the forest is critical."

The data collected by Brehm and Boone will be used for both their theses, as well as by future students and forestry industry employees.

"This research will feed into a longer-term study that will help forestry

managers better understand the role that seed predators have on the regeneration of Maine's forests, and can help inform their decisions about long-term [forest](#) management to maximize the success of target tree species," Boone says. "Healthy forests are beneficial for outdoor recreation, economically valuable and beautiful to look at."

Mortelliti says the results of his research may not necessarily be of immediate use, but they could make a difference in conservation and the long-term survival of a population.

Having healthy and viable populations of animals is even more important in today's rapidly changing climate, and it's up to humans to maintain this diversity of behaviors within populations, he says.

More information: Allison M. Brehm et al. Land-use change and the ecological consequences of personality in small mammals, *Ecology Letters* (2019). [DOI: 10.1111/ele.13324](https://doi.org/10.1111/ele.13324)

Provided by University of Maine

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