Landscape corridors can aid in fire ant spread, but the effects are transient

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The Corridor Experiment at the Savannah River Site in South Carolina is an 80,000-hectare site owned by the U.S. Department of Energy and administered by the U.S. Forest Service; it was designed to test the efficacy of corridors for conservation of biodiversity. Credit: Ellen Damschen

As habitat loss and fragmentation continues, many in the scientific community view landscape corridors as important for connecting habitat fragments to maintain biodiversity.

And yet, might those same landscape corridors make it easier for invasive species to spread and cause greater harm to biodiversity?

It's a question Julian Resasco, an assistant professor in the University of Colorado Department of Ecology and Evolutionary Biology, has been investigating for more than a decade. He now has an answer for one particular invasive species.

When Resasco first began researching the issue while working on his Ph.D., he found the perfect setting with the Savannah River Site Corridor Experiment in South Carolina, which is the largest corridor experiment site in the world. He also found an excellent test subject in Solenopsis invicta, more commonly known as fire ants.

Fire ants are considered one of the most problematic invasive species in the United States, to the detriment of native ant species, Resasco notes. Fire ants are native to South America, but have made themselves at home in the United States since the 1930s and today can be found in many southern states.

"The idea behind this experiment was to design an experiment to see how habitat fragmentation, and conversely, corridors, affect the movement of organisms and biodiversity," Resasco says. "And the Savannah River Site is an 80,000-hectare site owned by the U.S. Department of Energy and administered by the Forest Service, so it's one of the few places where large-scale experiments like this can happen."

Resasco says he initially contemplated focusing his research on small mammals, but eventually decided to study fire ants because they are so invasive. They worked well with the idea of potential negative effects related to corridors, and they also worked well for the scale of the experiment.

"Also, it's very easy to collect data on ants," he adds. "So, very quickly I had a cool question and lots of data. Because fire ants are very detrimental to co-occurring ants, I could look at how the fire ants respond to the corridors, and what the effect is on the native ants that live with them."

In some cases, fire ants will raid the nests of native ants, while in others they will simply monopolize the food and resources in areas they share with native ants and crowding them out, Resasco says, noting fire ants are more aggressive than their native counterparts.

Creating a large-scale testing area

To test whether corridors aided the spread of fire ants, the U.S. Forest Service created experimental landscapes called blocks. One block consists of a central patch created by clearing plantation forest, making a better habitat for fire ants, surrounded by three randomly assigned patch types: connected and rectangular or winged. (Rectangular and winged patches were unconnected to the central patch.)

Researchers used pitfall traps to capture ant workers over a period of years, including 2008 and annually from 2014 to 2019, to estimate the density of fire ants and native ants.

Resasco says research he published in 2014 in *Ecology* showed that fire ant biology played an important role in their degree of spread. Specifically, trait differences between monogyne (single egg-laying queen) and polygyne (multiple egg-laying queen) colonies were important predictors of fire ant population densities, their impact on local ants and the effects of corridors.

Notably, monogyne queens taking part in large aerial mating flights will establish new colonies as far as several kilometers away from their natal

homes, while polygyne queens disperse over shorter distances.

"When there is only one queen per colony (monogyne), the behavior of the ants is very different," Resasco explains. "They defend a big territory to keep other fire ants away, whereas in the polygyne social form there are many egg-laying queens per colony and they will not be aggressive toward non-nestmates. Instead of spreading out, they intermingle with each other and establish really high densities, which has more negative effects on the native ants."

As a result of their respective mating dispersal patterns, Resasco says his 2014 published research showed polygyne fire ants benefited from land corridors, while monogyne fire ants—aided by their ability to fly above the tree canopy and for longer distances—were readily able to establish new colonies in patches regardless of whether they were connected with corridors.

However, Resasco says he theorized in 2014 that the effects of corridors on polygyne fire ants were transient, meaning fire ant density differences between connected and non-connected patches would dimmish over time, as polygyne fire ants fully established themselves in patches. Now, with testing done over the past decade, research shows that is the case, says Resasco, who published his latest findings in *Ecological Entomology*.

"Oftentimes, invasive species are invasive because they're really good at getting around, so corridors might not make a big difference one way or another if the species can readily colonize," he says. At the same time, fire ants are just one example of invasive species, so there may be cases in which the benefits of land corridors should be carefully weighed against drawbacks.

While meta-analysis articles published in *Current Landscape Ecology Reports* and *Conservation Biology* by Resasco and his colleagues found

much evidence of positive effects of corridors and limited evidence of negative effects, Resasco notes that "there could potentially be times when connecting corridors could have some negative effects we should consider," adding negative effects of landscape corridors are much less studied than positive effects. Study by other researchers on aspects landscape corridors related to fauna, insects and animals is ongoing, he adds.

"The value of research sites like the Corridor Experiment at Savannah River Site is we can develop theories of how things work and test them out on larger-scale models," Resasco concludes. "That was the value of the study here."

Provided by University of Colorado at Boulder

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