

is 20 million years older than if we just looked at body fossils,” Wilf points out.

These findings lend support to a theory proposed by Farrell in 1998. Farrell suggested that most plant-eating beetles likely evolved in parallel to flowering plants and therefore were quite diverse during the dinosaur’s heyday (*Science*, 24 July 1998, p. 555). But until now, there has been little supporting fossil evidence, as only one relevant beetle fossil exists from that time. Now researchers may be able to get around this lack of fossils by looking at insect damage instead, says Leo Hickey, a paleobotanist at Yale University: “The work shows the potential of an overlooked resource in [studying] the evolution of insects.” Inspired by this new work, Hickey expects that he and his botanical colleagues will be giving their plant fossils a second look for signs of insect activity. Coley agrees, noting that “it seems that the use of fossil damage patterns to infer ecological and evolutionary relationships is quite powerful.”

—ELIZABETH PENNISI

ECOLOGY

When Fire Ants Move In, Others Leave

For Amy Arnett, getting a Ph.D. in biology has also meant learning to be a road warrior. Beginning in May 1997, she and Christy Royer, an undergraduate assistant, covered some 2000 hot, dusty kilometers from northern Florida to upstate New York, collecting ants at 33 sites along the way. They had set out to look at how the food resources for ant lions, insects that prey on ants, changed from north to south along the East Coast. But in the process, their research uncovered new evidence about the long-range, and potentially long-term, ecological damage being wrought by an invasive species of fire ant.

The red imported fire ant *Solenopsis invicta* displaces other ant species and upsets the structures of native communities of ants—disruptions that appear to be permanent, Arnett and her adviser, community ecologist Nick Gotelli of the University of Vermont, Burlington, report in the July issue of *Ecology Letters*. Other studies have examined how these ants perturb single communities and how other invasive species affect the communities they move into, says David Holway, an ecologist at the

University of California, San Diego. But this “is the only study that looks at the impact of an invasive species at such a broad scale.”

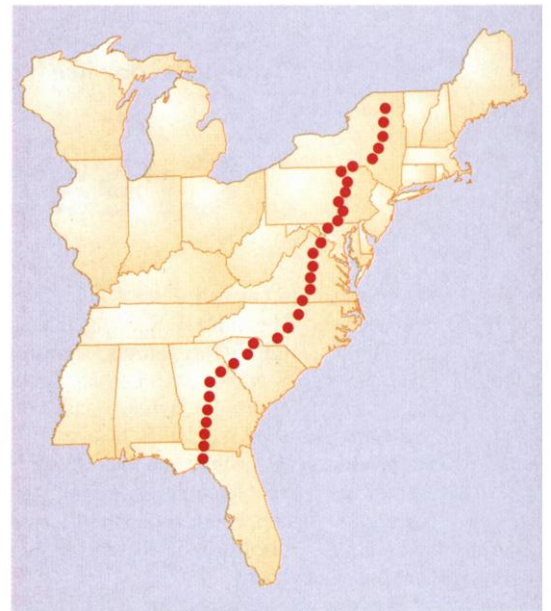
These fire ants entered the southeastern United States about 70 years ago, likely hitching a ride with produce from Argentina or Brazil, and have spread as far north as winter freezes will let them. They are infamous for their sting, which “you never forget,” says Gotelli. They can also make pastures uninhabitable for livestock and chew up telephone wires. But “what people [haven’t understood] is the ecological havoc they are wreaking,” says Kenneth G. Ross, an entomologist at the University of Georgia, Athens.

As Arnett and Royer drove along the East Coast between 25 May and 3 July, they would scan the horizon for a sampling site—an open field next to a forest—roughly every 30 to 50 miles. In both the field and the forest they would make a 5-meter-by-5-meter grid in which they buried 25 small plastic tubes, each placed so its lip was flush with the ground. Soapy water at the bottom of the tube prevented the escape of any creature that crawled in over the next 48 hours. In this way the roving researchers could get a quick snapshot of the ants active in both habitats.

When they retrieved the tubes, Arnett and Royer could tell right away whether fire ants were present. If none were there, the tube was relatively empty, likely containing only about 20 ants of assorted species. But if the red ants were there, as many as 500 individuals would be crammed into each tube—a readily visible mass. Almost all would be the red imported fire ants, which live in denser populations than do native ants.

Overall, the effort netted more than 14,000 ants, and with the help of Harvard ant specialist Stefan Cover, they identified 81 species, including *S. invicta*. What was surprising was the distribution of those species. The researchers had expected to find more native species in the southern part of the country than in the north, as species diversity tends to increase closer to the tropics.

But where fire ants were present, that gradient was disrupted. Arnett and Gotelli found that, as expected, the number of species rose with decreasing latitude—from just a few in New York to 15 in southern Virginia. But the number of native species dropped off at sites farther south, slipping back down to four in Florida, Gotelli and Arnett report. “These changes correlate very strongly with the pres-



Hot on the trail. Researchers surveyed ants at 33 sites (dots) along the East Coast.

ence and absence of fire ants,” points out Lloyd Morrison, an entomologist at the U.S. Department of Agriculture’s Agricultural Research Service Center in Gainesville, Florida. (North Carolina is the northernmost range of the red imported fire ant.)

Gotelli and Arnett can’t tell from their survey whether the missing species are locally extinct or just very rare. But the drop in biodiversity could represent a significant loss for these areas, notes Ross, because of the critical role ants play in recycling nutrients and other biological material. Although the red imported fire ants are voracious feeders, they may not redistribute nutrients in the same way that a variety of other ants—each with its own particular habits—would, Gotelli explains. What’s more, the steadily declining number of ant species found below the northern limit of the red fire ant suggests that habitats don’t recover their biodiversity with time.

Not only does the red ant reduce the overall number of ant species at a given locale, but it also alters the community structure. When Gotelli and Arnett analyzed their data, they found that certain native species tend to coexist with certain others, likely dividing up the resources to make efficient use of what’s available. Some might eat seeds; others might concentrate on leaves, for example. But where fire ants are present, those associations break down—a change that could affect the efficiency of the food webs at those sites, Gotelli suggests.

All in all, says Ross, the study “shows very nicely the large-scale ecological effects [red ants are having] on other ants”—and it was a trip well worth taking.

—ELIZABETH PENNISI



Dreaded invader. Red imported fire ants displace native ants and disrupt local ant communities.