

Africa's biggest mammals key to ant-plant teamwork

January 10 2008

Now researchers are reporting that in Africa, this plant-insect teamwork depends on the very antagonist it is intended to ward off: Africa's big browsing mammals.

In a paper set to appear this week on the cover of the journal *Science*, the researchers report that elephants, giraffes and other large plant-eaters spur Acacias to "hire" and support ants as bodyguards – and without the mammals, the trees slash their investment in ants, opening both to other attackers. Because many of the mammals are threatened by human activities, the paper's conclusions serve as a cautionary tale of how people can influence the ecosystem as their impacts cascade down unexpected paths.

"Throughout sub-Saharan Africa these large mammals are threatened by human population growth, habitat fragmentation, over-hunting, and other degradation, so we have to wonder how their loss will affect these ecosystems," said Todd Palmer, the paper's lead author and an assistant professor of zoology at the University of Florida. "The last thing you would think is that individual trees would start to suffer as well, and yet that's exactly what we see."

Scientists have observed mutualism, or cooperative interactions between different species, throughout the natural world. The phenomenon is also well-known among plants and insects, with some of the earliest observations surrounding ants and plants in Central America.

What sets the Science paper apart is that it shows how easily these relationships, which likely have evolved over many millennia, can fall apart once a critical cog is removed.

Acacias are mostly shrubby trees common across the tropics and sub-Saharan African savannah. They have swollen thorns that serve as nests for three species of biting ants. Healthy trees have hundreds of the thorns, often containing more than 100,000 ants per tree. Both the ants and the trees benefit from their close cohabitation. The ants get the thorny shelters, as well as nectar they collect from the bases of Acacia leaves. Because the ants swarm in defense against anything that molests the trees, the trees get protection from their chief ostensible nemeses, browsing animals.

That's when the mutualism is working well. But the research got its start when Palmer noticed that certain Acacias at his research site in central Kenya, which had been fenced off from wild herbivores, looked sickly compared with their unfenced counterparts. That was the opposite of what might be expected, because the browsers feed voraciously on the trees.

Palmer noticed that the sickly trees appeared to have fewer thorn nests, so he began measuring that and other differences on the trees in six experimentally fenced plots and six open plots. The former had been surrounded by an 8,000-volt electric fence for 10 years.

The observations confirmed the fenced trees had fewer swollen thorns. The research also revealed that the fenced trees had fewer active "nectaries" at the base of leaves where the ants sip the trees' nectar. That indicated the trees were producing less nectar.

Moreover, when Palmer and other researchers jostled the fenced trees, the ants were far less defensive than their counterparts on the unfenced

trees. There, the slightest disturbance spurs hundreds of ants to pour out of the thorns.

Without mammals around to eat the trees, sheltering fewer, less aggressive ants would not present a cost to the trees. To the contrary, the trees would seem to be better off, because they would not need to use their resources to support the ants.

But the research revealed that the fewer colonies of weakened ants become less able to defend their territory from another species of ant that, unlike the others, does not have a mutually beneficial relationship with Acacias. Instead, this fourth ant species feeds away from the tree and does not protect it from attackers – in fact, it actually encourages a destructive, wood-boring beetle whose cavities then serve as this ant’s home.

The result appears to be that the trees untouched by browsing mammals are infested with more of the beetles, which is part of the reason that they fare poorly.

Another problem for the fenced trees may be that their ants appeared to gather nectar-like secretions from more aphid-like insects than those on the unfenced trees. This could also serve to weaken the fenced trees, Palmer said. The fenced trees were twice as likely to die as the unfenced ones, and they grew 65 percent more slowly, the paper reports.

“You get a community-wide replacement of ‘good ants’ with ‘bad ants,’ and the result is that the trees start doing poorly,” Palmer said.

One irony of the findings is that the trees have developed their mutualistic relationship with the ants to protect themselves against plant-eating mammals – and yet because of that relationship, the trees wind up actually needing the mammals.

“If you get rid of the large mammals, it shifts the balance of power, because the trees default on their end of the bargain,” Palmer said. “When the trees opt out, their hard-working employees starve and grow weak, which causes them to lose out. So, ironically, getting rid of the mammals causes individual trees to grow more slowly and die younger.”

The research has important implications for conservation.

As Palmer said, “It’s becoming increasingly clear that anthropogenic change can have rapid and unanticipated consequences for cooperative species interactions, and we caught this happening in real time.”

Source: University of Florida

Citation: Africa's biggest mammals key to ant-plant teamwork (2008, January 10) retrieved 30 May 2023 from <https://phys.org/news/2008-01-africa-biggest-mammals-key-ant-plant.html>

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