Beavers bite trees, benefit baby beetles

At the first nibble by a plant-eating animal, many trees fight back by releasing noxious chemicals into their leaves. When a beaver chomps on a cottonwood, however, that strategy misfires. The bitter compounds in the tree's regrowing shoots attract a leaf-eating insect.

Cottonwood leaf beetles prefer the leaves that sprout after a beaver has cut a tree down, report researchers from Northern Arizona University in Flagstaff. Beetle larvae that eat the new growth co-opt the nasty compounds to protect themselves.

"The thing that's neat about it is that it's a positive interaction," says Gregory D. Martinsen, a coauthor of the report in the January ECOLOGY. "The beaver herbivory ends up benefiting the beetle."

Compared to the cottonwood's normal juvenile growth, the resprouts contain twice the concentrations of phenolic glycosides, aspirinlike compounds that repel other herbivores. Nevertheless, resprouts attracted 15 times as many adult *Chrysomela confluens* beetles, the scientists report. Beetle larvae were also more numerous on new growth. In an experiment, they grew faster and larger on the resprouts than on juvenile sprouts.

"In theory, the [change in] chemistry should be worse for the beetle," says ecologist Mark D. Hunter of the University of Georgia in Athens, "but the beetle does something very clever with that chemistry."

The larvae store the chemicals in their glands as a defense against predators, explains Martinsen. When disturbed, the larvae turn the glands inside out, exposing drops of foul-smelling, bitter-tasting fluid.

Ants, which eat beetle larvae, are common on cottonwood trees. Martinsen and his colleagues tested the potency of the chemical defense by placing larvae on ant mounds.

"The bravest ant attacks the [larva], and the glands come out. The ants literally do back flips to get away from it," he says. "This happens several times."

The researchers found that larvae which were fed resprouts could hold out against the ants 28 percent longer than larvae fed normal juvenile leaves.

Such studies of indirect effects, in which an interaction between two species affects a third, are a burgeoning area of research for ecologists.

"Although the idea that everything is connected to everything else has been around for at least a century," says J. Timothy Wootton, an ecologist at the University of Chicago, "good experimental evidence that that is indeed the case has only recently been available." —*M. Jensen*

Martinsen and M. Kearsley/Northern Arizona Univ.

A cottonwood tree resprouts after having been cut down by a beaver. Inset: A cottonwood leaf beetle larva turns the defensive glands along its back inside out, exposing drops of smelly chemicals that the insect collected from cottonwood leaves.

Blood tests establish early HIV case

Exhaustive analyses of a blood sample taken from an African man in 1959 have confirmed the earliest known case of infection with HIV-1, the virus that causes most AIDS cases worldwide.

The finding establishes that HIV was present in people a decade or two earlier than scientists had thought, said Tuofu Zhu of the University of Washington in Seattle, speaking in Chicago this week at the 5th Conference on Retroviruses and Opportunistic Infections.

The man from whom the sample was taken lived in Leopoldville in the Belgian Congo, now Kinshasa in the Democratic Republic of the Congo. His fate is unknown. The man's blood had been preserved as part of a study of blood diseases and was first identified as HIV-positive in 1986, when researchers performed basic immunological tests on it and 1,212 other samples obtained from African patients between 1959 and 1982.

The information collected on the virus at that time was limited by several factors. Scientists then couldn't multiply tiny amounts of viral DNA many thousandfold, as they can today; they lacked knowledge of several HIV-1 subtypes; and they did not have extensive databases of viral DNA.

To find this blood sample's place in the evolution of HIV, Zhu and his colleagues converted viral RNA from the sample into DNA and then made thousands of copies of the DNA. The process yielded copies of a few strands of DNA consisting of about 300 nucleotides each. These sequences of HIV-1 found no perfect match among databases of modern HIV-1 sequences.

"The 1959 [viral DNA] sequence was not a mosaic of modern subtypes" of HIV-1, Zhu said at the meeting.

HIV has mutated many times since 1959, and this early sample may provide insights into that process, the researchers suggest in the Feb. 5 NATURE. They speculate that all cases of HIV-1 may stem from the introduction of the disease into the African population in the years preceding 1959.

The new analysis shows that the virus in the 1959 sample is closer to a prototype virus than modern HIV-1 is, Zhu says. He and his colleagues found similarities between the old sample and three modern subtypes of HIV-1. Because HIV evolves at a somewhat predictable rate, the researchers could place the sample on a time line leading back to an ancestral HIV-1. They estimate that all subtypes of HIV-1 share a common ancestor "in the late 1940s or early 1950s," Zhu says.

While the finding doesn't reveal the origin of HIV, many scientists suspect that HIV-1 came from chimpanzees and HIV-2 from monkeys called sooty mangabeys. The 1959 sample of HIV-1 is more similar in structure to modern HIV-1 than it is to immunodeficiency viruses in nonhuman primates, an indication that the global spread of HIV-1 occurred only after it had invaded humans, says Simon Wain-Hobson of the Pasteur Institute in Paris in an accompanying commentary.

The finding may prove to have more than historical or academic interest.

"Knowing where something came from and how it ever got into humans in the first place . . . would be very important information, because who's to say there aren't more viruses out there that we just don't know how to detect right now," says molecular biologist Michael H. Malim, a Howard Hughes Medical Institute investigator at the University of Pennsylvania Medical School in Philadelphia. —*N. Seppa*