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Hotter Climate Is Linked to Insect Attacks

BY LEE SIEGEL
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Insects became more diverse in southwestern Wyoming and did more damage to plants when the climate warmed up 53 million years ago, Smithsonian Institution researchers reported today.

Their study suggests climate is the key reason insect and plant populations are more diverse in the tropics than in temperate zones.

But does it mean modern-day global warming will send hordes of bugs munching through crops?

"Plants probably will suffer greater damage by insects, but not because of the same mechanisms happening 50 million years ago," said ecologist Lissy Coley, a University of Utah biology professor.

That is because modern warming of Earth's climate is much more rapid than the prehistoric episode studied by Peter Wilf and Conrad Labandeira of the Smithsonian's National Museum of Natural History in Washington.

Their study of bug-bitten leaf fossils was published in the journal Science. Land plants and insects make up most of Earth's biodiversity, and almost half the insects eat plants, they said.

So "understanding the interactions between these two groups is fundamental for understanding life on Earth," Coley wrote in an accompanying commentary.

The Smithsonian researchers studied leaf fossils from southwestern Wyoming's Green River, Great Divide and Washakie basins. The plants lived during the relatively cool Paleocene Epoch 65 million to 58 million years ago and the warmer Eocene Epoch 58 million to 38 million years ago.

During several million years, the area's mean annual temperature warmed from 58 degrees Fahrenheit to a peak of 70 degrees 53 million years ago. By comparison, the mean annual temperature -- an average of all seasons and hours -- was 52 degrees in Salt Lake City from 1948 through 1990.

Previous research showed that as the prehistoric climate warmed, all dominant plant species were replaced by new species, and plant diversity increased.

In the new study, the researchers found 41 types of insect damage on leaves of 39 flowering-plant species from the Paleocene Epoch and 49 from the Eocene. They discovered insect bite marks on plants became more abundant and were made by more species of insects as the climate warmed.

Coley said evidence that climate warming at a single latitude can increase plant and insect diversity supports the theory that a warm climate is responsible for rich tropical biodiversity.

Another theory is that the tropics were not disturbed by Ice Age glaciers and thus are older and have had more time to develop greater biodiversity. A third theory is the tropics have greater land area, thus more niches and more diversity.

Prehistoric global warming was slow enough to allow what Coley called "a co-evolutionary arms race" during which mild winters allowed more insects and plants to survive and diversify.

"You had insects eating plants so the plants evolved defenses like chemicals or spines or toughness," Coley said. "Then the insects evolved adaptations, such as enzymes that could detoxify the chemicals or bigger mandibles to chew tough leaves. Then plants countered again with changes in their defenses. It was an escalating battle between plants and insects."

Such slow evolutionary change took millions of years, but global warming today is much more rapid, so insects and plants won't have time to adapt and diversify, Coley said.

She expects global warming to reduce populations of birds, wasps, spiders, ants and parasites that prey on insects, so insect populations could grow and do more damage to plants. But the diversity of insect and plant species may drop as some fail to survive a warmer world, she added.

Global warming also is expected to change rainfall patterns, wrecking some farming areas or changing what crops can grow there. Coley said warmer nights will reduce crop yields by increasing nighttime respiration, so plants will burn more calories.

"Current climate change will disrupt the fine-tuned relationships between plants and insects that have evolved over the eons," Coley said.