Warmer climate spurred ancient plant pests

In one of the longest-running wars on Earth, plants and insects have been battling each other for more than 300 million years. The fiercest skirmishes play out in the tropics, where hordes of hungry pests attack vegetation protected by multiple defensive weapons. A pair of paleontologists has now used ancient leaf fossils to decipher what it is about the tropics that brings out the worst in insects and plants.

Ecologists have long recognized that life is most exuberant near the equator, whereas other regions have fewer species. With the increase in tropical species come enhanced opportunities for insects to munch various plants. Researchers have wondered whether temperature, light, topography, or other factors can explain the latitudinal differences in insect herbivory.

The rocks of western Wyoming record a natural experiment capable of answering that question, report Peter Wilf and Conrad C. Labandeira of the Smithsonian Institution's National Museum of Natural History in Washington, D.C. From these rock formations, the two researchers excavated two sets of leaf fossils. The older group dates from the Paleocene epoch, 56 million years ago, when global temperatures were rising. The younger group hails from the Eocene epoch, 53 million years ago, during which temperatures reached a peak.

Comparing the damage patterns found on the fossil specimens, the researchers determined that insects took a larger bite out of plants in the Eocene. In that epoch, "plants were being more intensely attacked, and there were more types of things doing the attacking," says Labandeira. He and Wilf describe their results in the June 25 SCIENCE.

Most studies of modern plant herbivory make comparisons among sites at various latitudes, but the fossil study examines two different populations from the same latitude and the same type of floodplain environment. The prime difference between the samples is temperature, say the researchers. The later time was 7°C warmer than the earlier.

Chip Clark/National Museum of Natural History

Ancient wounds mar a 56-million-year-old fossil leaf from southwestern Wyoming. The larvae of a fairy moth ate away these circular splotches.

In their recent work, the two scientists have extended the study by looking at fossils postdating the peak Eocene warmth. As temperatures dropped, so did the frequency of insect damage to leaves, says Labandeira.

The researchers caution against applying the results of their study to current climatic concerns. "This is not a prediction about what will happen in the next 100 years as temperatures go up," says Wilf. The Paleocene and Eocene warming evolved over millions of years, much slower than the one occurring today.

"Although Wilf and Labandeira's study may not be able to directly predict future changes in plant-herbivore interactions, it goes a long way toward explaining present and past communities," says Phyllis D. Coley of the University of Utah in Salt Lake City, who wrote a commentary in the same issue of SCIENCE. "Wilf and Labandeira," she says, "push the fossil evidence farther than ever before by quantitatively testing ecological hypotheses." —*R. Monastersky*

Nocturnal spider favors artificial lights

Spiders that spin their webs near lights at night to feast on bedazzled insects may be responding to more than the abundance of easy meals. For the first time, say researchers, a laboratory test has shown that a spider that feeds at night has an inborn preference for building webs near artificial light.

Webs of the spider *Larinioides sclopetarius* hanging along a footbridge over the Danube Canal inspired Astrid M. Heiling of the University of Vienna to study arachnid light preferences. More spiders cluster on handrails with built-in lights than on those without illumination, she reports in the June BEHAVIORAL ECOLOGY AND SOCIOBIOLOGY. In the lab, even spiders raised without artificial light built their webs near it on the first exposure.

Heiling's work adds to a growing appreciation of the sophistication of web building, comments Mark A. Elgar of University of Melbourne in Parkville, Australia. "It really shows these aren't just some kind of sit-and-wait predators that lead uninteresting lives," he says.

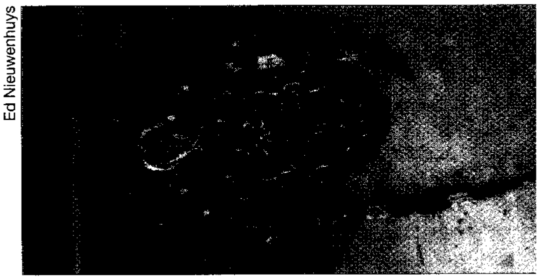
The species that Heiling studied lives near European waterways and has been reported at North American sites including New York City docks. Among adults, only females, which grow to 14 millimeters long, spin webs. Males, which are smaller, snitch prey from the females' webs.

The spiders can't break through human skin, Heiling reassures people who might blunder against them. "There is no reason for arachnophobia," she says.

Surveying the Danube footbridge from May to October, Heiling found that lit handrails averaged more than four times the spider density of the unlit ones.

To test light preferences, Heiling placed spiders at the dividing point of a two-chambered box, lit on one side and blacked-out on the other. She kept the temperature equal in the halves. Eighteen out of 20 females Heiling collected from the bridge spun webs in the lighted portion.

She also raised spiders without artificial light and fed them in both darkness and daylight so they would not associate light with food. When put into the artificially lit test box, 14 out of 15 spiders chose to build webs in the light side.



Ed Nieuwenhuys

This nocturnal orb-web spider shows an intriguing preference for light.

The behavior may have evolved as spiders came to select sites near reflections of moonlight on water, she speculates.

A test by other investigators had found that another nocturnal orb-web spider avoids light. However, Elgar says he wouldn't be surprised if other nocturnal species turn out to favor city lights. "Where you find a streetlight, you find the odd spider hanging about," he notes.

His studies and others are bringing to light ways that spiders adjust their webs to maximize meals. Orb-web species fine-tune the total area and the mesh size of their webs. For example, hungrier spiders tend to build bigger webs.

A spider with a web that gets repeatedly bashed switches to a more tranquil location. Also, some spiders active in daylight decorate their webs with insect-attracting, UV-reflective silk squiggles. When spinning a web in a shady spot, they use more of this tinsel. A well-fed spider also invests more in decoration. "If you're well-heeled, you tend to eat more expensive food," Elgar muses.

Building good webs demonstrates real hunting prowess, he argues. A cheetah's chase to bring down dinner by sheer muscle power is "spectacular," he says, but "to our way of thinking, that's not very sophisticated." —*S. Milius*