RESEARCH

Findings May Help Slow Gypsy Moth's Destructive March

RESEARCH CONDUCTED BY A UL Lafayette biologist and some colleagues may someday help slow the spread of the devastating gypsy moth.

The leaf-eating insect has invaded more than 380,000 square miles of forest in the northeast United States since it was accidentally released in 1869. It defoliates up to 31,000 square miles of forest yearly.

Dr. Derek Johnson, an associate professor of biology at UL Lafayette, is a member of a team that has studied records of gypsy moths' movement. Its findings were published in the November issue of *Nature*, a scientific journal.

An amateur entomologist living near Boston in the 1860s kept a variety of caterpillars, including gypsy moth caterpillars. Some escaped and by the 1890s, they had multiplied and taken over nearby forests.

Johnson and his colleagues studied historical data about gypsy moth movement. They found that invasion pulses were periodically interspersed among years of slow rates of spread about every four years.

"We believe that this is the result of what is called 'the Allee effect.' That occurs when a low-density population has a depressed population growth rate," Johnson said. "When there are too few individual gypsy moths, then the population may have a hard time growing larger and, in fact, may get smaller and eventually die out."


SCOTT BAUER / USDA

Gypsy moth caterpillar

Why does the gypsy moth population ebb and flow?

The female gypsy moth is a major factor. Unlike the male gypsy moth, she cannot fly. "The most obvious potential cause of Allee effect is that the population density is so low that females have problems finding mates. In that case, they would be unable to reproduce and would become extinct locally," Johnson said.

Conversely, female gypsy moths also contribute to population surges. "They have a rather odd behavior of laying eggs on various items, such as vehicles and camping equipment. Humans then move their eggs beyond the gypsy moth's range inadvertently," Johnson said. When those hatch and the young moths reproduce, the population increases and surges ahead.

But this can only occur, when there are enough males from within the gypsy moth's range to disperse and mate with these females, because the males in egg mass usually disperse after hatching. Otherwise, Allee effects would doom this isolated population. Johnson and his team suggest that there are only enough males to overcome Allee effects when gypsy moth populations within its contiguous range are at outbreak levels.

Suppressing populations within the contiguous range prevents the isolated populations from overcoming the Allee effect.

Other team members are Dr. Ottar Bjørnstad, an associate professor of entomology and biology at Penn State; and Andrew M. Liebhold, a research entomologist, and Patrick C. Tobin, a research ecologist, who work with the U.S. Forest Service in Morgantown, W.V.

OIL COMPANIES CAN COMBAT NEMESIS WITH SOFTWARE

Software developed at UL Lafayette is helping companies around the world avoid costly oil spills.

It predicts where corrosion is most likely to thin pipeline walls, creating areas that could spring a leak. That's good news for consumers, since the price of gasoline can rise when the flow of oil is interrupted.

Dr. James Garber, a professor and head of UL Lafayette's Corrosion Research Center, said it has developed three computer-modeling programs since the mid-1980s. The first and second forecast where and when corrosion will occur in oil wells and natural gas wells. The sophisticated software is used by major oil companies, such as Shell, Chevron and ExxonMobil, in many countries, including Africa, Brazil and Canada.

"These computer models have put UL Lafayette's name on the map, as far as corrosion is concerned," Garber said.

"In December, we released a brand new software package that models the corrosion rate in flowlines and pipelines. So our products now cover from bottom hole production all the way to shore."

UL Lafayette researchers are already working on a fourth computer model. It will identify potential corrosive spots in pipelines caused by bacteria.

Garber said oil companies can monitor levels of bacteria activity. "If they spot it, then from that amount of bacteria, we can predict how much the corrosion rate will increase above the normal prediction. That's the number they're looking for."

The software is attractive to companies from an environmental standpoint, he added, since it's another tool they can use to protect natural resources from damage caused by oil and gas leaks.

UL Lafayette students benefit from the computer models, too.

"We try to get our students trained on it here and it has helped a few of them get jobs," Garber said.

The computer models were produced by many faculty in UL Lafayette's Chemistry and Chemical Engineering departments over the past 25 years, he added.

Exchange Gives Petroleum Engineering Students An Edge

Some UL Lafayette petroleum engineering students have gotten valuable training in deep-water oil production, thanks to an exchange program with two universities in Brazil and another in Houston.

The Brazilian universities were chosen for the partnership because most of Brazil's oil production activities are in deep waters, said Dr. Ali Ghalambor, an endowed professor and head of UL Lafayette's Petroleum Engineering Department." So, historically speaking, Brazil was operating in deep waters before we were drilling in deep waters in the Gulf of Mexico," he said.

In 2003, Ghalambor obtained a $215,000 grant from the U.S. Department of Education to establish an exchange program with the University of Houston, the University of Campinas and the Universidade Federal do Ceará.

About 20 UL Lafayette and UH students have each spent about five or six months in Brazil at one of the two partner universities, while about 30 Brazilian petroleum engineering students have done the same in Lafayette or Houston.

Brazil is the largest and most populous country in South America. It produces an estimated 1.5 million barrels of oil per day; the U.S. produces about 7.5 million barrels of oil per day.

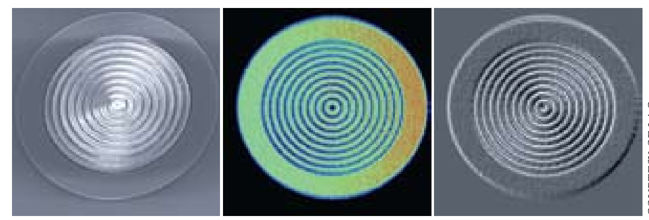
Ghalambor said exchange programs with other countries are an important resource for UL Lafayette students. "In the petroleum industry, you may end up working somewhere else in the world," he said. "It gives our students an edge to be able to function in other cultures and geographic regions."

The four-year program will end in September, but Ghalambor said he can apply to extend it. A third Brazilian university and another United States institution have expressed interest in participating in the exchange program if it continues, he added.

MICRO-IMAGING PROCESS AT UL LAFAYETTE CENTER SHOWS PROMISE

Researchers at UL Lafayette's Louisiana Accelerator Center have found a new way to look at material.

First, they use a beam of ions to produce a two-dimensional map of a substance's density. Using an original mathematical theory, they can then convert that map into a 3-D image.


COURTESY OF LAC

The microstructure shown in the electron microscope image on the left was fabricated at LAC using the high energy focused ion beam system. The color image in the center represents the energy loss of a proton microbeam as it passes through the structure. The lighter the color, the more energy loss. The computerized structural density image on the right was reconstructed from the energy loss image using a new 3-D micro-imaging process developed at LAC to study microstructures in biological materials.

Can't computer software already do that, using existing algorithms? Yes, but that software adds information, according to Dr. Gary Glass, a UL Lafayette physics professor and LAC director. So the image is no longer pure; it doesn't necessarily relate to the original object.

But, LAC researchers can produce a 2-D map of a material's density by using a beam of ions. They measure energy loss that occurs when that beam travels through the substance.

Using a groundbreaking mathematical theory, they can then convert the energy loss data into a 3-D image – without adding any information to it. "That's important because what we want to do eventually is to use this as a way to measure small structures in materials," Glass said.

This new mathematical technique, known as photometric imaging, combined with an existing technique called scanning transmission ion microscopy, has potential applications in many areas, such as biology and medicine.

LAC researchers have been conducting tests using a high energy focused ion beam system to first fabricate microstructures, obtain STIM maps and then apply the photometric imaging technique. But initial research indicates that the photometric imaging technique could be applied to more common transmission electron microscope images.

"This technique, as far as we can tell, has not been used by anybody," Glass said. LAC researchers will submit a paper for publication in a scientific journal. But Glass said the significance of their work lies in the potential "real world" application of an original mathematical theory.

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