Polar Worms May Warn of Global Warming, Experts Say

Bijal P. Trivedi
National Geographic Today
September 12, 2003

In the McMurdo Dry Valleys of Antarctica, worms are the most sophisticated life-forms around.

The valleys are so cold, arid and bleak that they are used to simulate conditions on Mars. No plants, birds or insects survive there. But beneath the rocky, frozen polar soil dwell microscopic worms called nematodes that may be harbingers of the effects of climate change throughout the world.

Every year since 1989, Diana Wall, a soil ecologist and director of the Natural Resource Ecology Laboratory at Colorado State University in Fort Collins, has come to the valleys to help identify and understand the spectrum of microscopic creatures that make up the soil's food web. She wants to know what will happen to this web if the climate changes.

"Four out of five animals on Earth are nematodes," Wall says. About 15,000 species have been identified, and Wall suspects that there may be thousands if not millions more to discover. Common nematode parasites include roundworm and ringworm.

Nematodes and other microfauna help boost soil fertility by accelerating decomposition and decay, recycling the nutrients and making them available to plants. "Basically you have got to care about soil if you want to eat," Wall says.

For scientists, a challenge is to gauge how the microscopic soil creatures will react to warmer global temperatures.

"If you raised the temperature in Central Park and tried to understand all the changes that were happening, you couldn't do it—there are too many organisms and too many species," says Byron Adams, Wall's colleague, an evolutionary biologist and nematode expert at Brigham Young University in Provo, Utah.

Worms in Suspended Animation

For example, handfuls of dirt from the base of six plants in the tall-grass prairies of Kansas yielded more than 350 species of nematode, with thousands of other species and millions of individuals.

In the Dry Valleys the food web is basic. The main players are the bacteria that live in the soil and the three species of nematode that feed on them.

Taylor Valley, a 40-minute helicopter ride from McMurdo Station, the largest research facility in Antarctica, is one of the coldest, driest places on Earth, with temperatures averaging –4 degrees Fahrenheit (–20

Celsius); and precipitation equivalent of less than four inches (10 centimeters) of rain per year.

"This place is a natural laboratory," says Rob Jackson, a global change biologist at Duke University in Durham, North Carolina, who is familiar with Wall's work. "With fewer species it is much easier to see the cause and effect when you manipulate the ecosystem."

Already Wall's team has observed the impact of an 8-year-long cooling trend in the Dry Valleys. To the scientists' surprise, populations of all three nematode species have decreased.

"These worms are tough, and we thought they would thrive if it got colder," Wall says.

All three species of nematode survive the nine-month winter by dehydrating themselves and triggering a state of suspended animation called anhydrobiosis. With summer and rising moisture the worms wriggle back to life.

"Just add water and these things start kicking again," says Adams.

Greenhouse Effects in the "Worm Farms"

The researchers suspect that the cooler temperatures do not provide enough opportunities to reanimate and reproduce. If the cooling trends continue, all the species of worm could be susceptible to extinction, says Adams.

In their "freeze-dried" state the nematodes may literally blow away. Some of these windblown nematodes may land in wetter, more hospitable soil near lakes and streams—and survive the colder temperatures.

To help determine how temperature and other factors affect the worms of the Taylor Valley, Wall has set up more than 100 open cones, or "chambers," housing different experiments in areas dubbed "worm farms." Some 32 chambers have operated since 1993. Each cone creates a greenhouse effect, raising the temperature of the soil about 1 to 2 degrees Fahrenheit (2 degrees Celsius).

So far the warmer temperatures in the cones have also led to a decline in nematode populations.

"The heat dries the soil, acting like a wick and pulling up all the moisture," says Wall.

Warmer global temperatures could threaten nematodes and other microscopic players in the soil food web—ultimately changing the chemistry and nutrient content of the soil, according to Wall. "So far, though, our results are inconclusive," she says.

During the next 50 to 100 years, global surface temperatures will rise by an average of about 5 degrees Fahrenheit (3 degrees Celsius), according to the International Panel on Climate Change,

established by the World Meteorological Organization and the United Nations Environment Program.

The most important players in the future of climate are much more sophisticated creatures than the Antarctic worms.