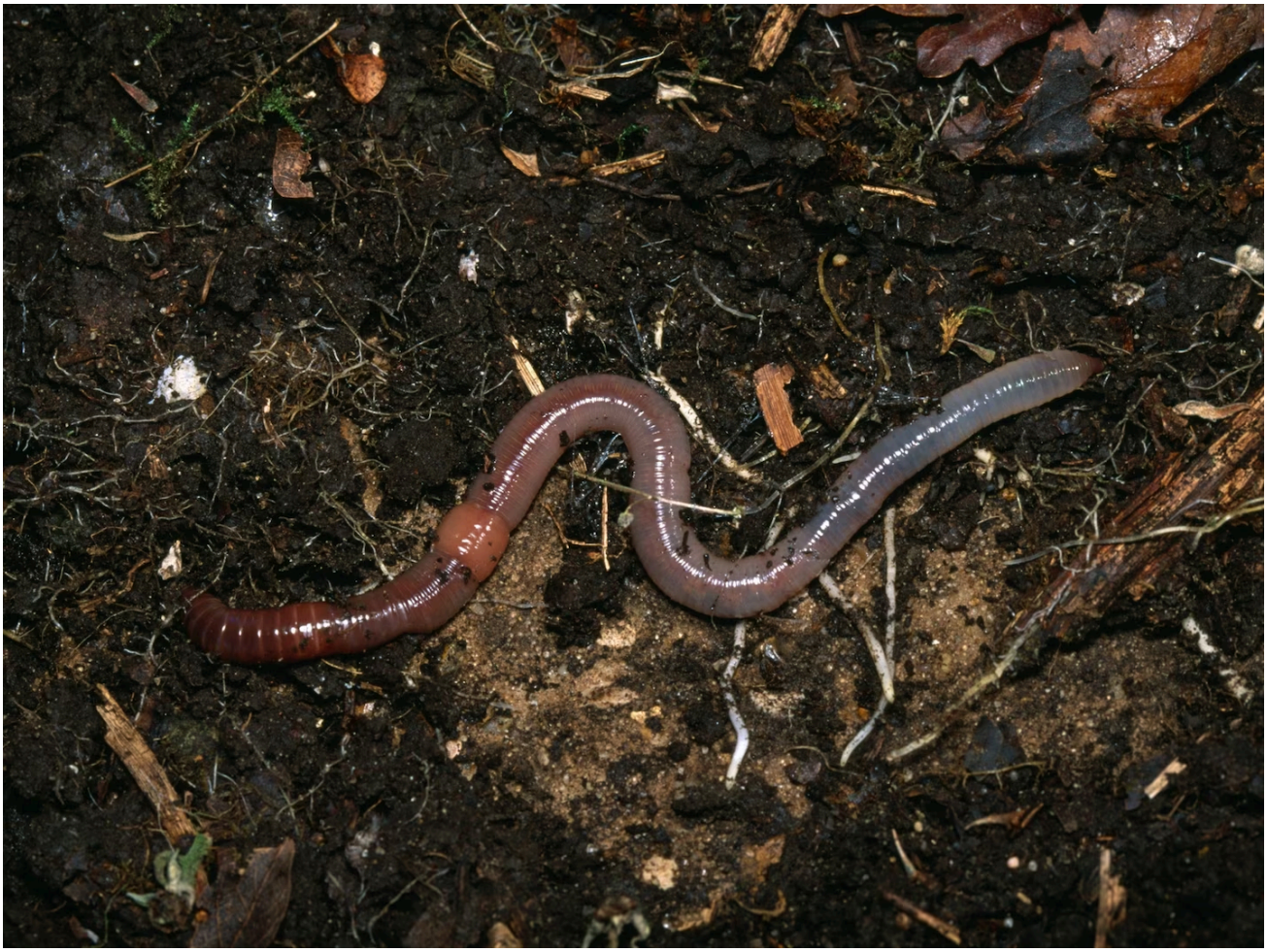

Earthworms are helpful in gardens but have surprising negative impacts on native animals in places where they don't belong, such as many North American forests.
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ANIMALS

Earthworms are invasive—and likely hurting insects—in much of North America

Often considered a gardener's best friend, earthworms are harming native species in forests where they don't belong.

By Alex Fox
March 29, 2022 • 8 min read

In the past five years, reports of staggering insect declines have stoked anxiety and debate concerning the fate of the "little things that run the world," as the late biologist E. O. Wilson once called them. As for the how and why of these declines, the prime culprits are habitat destruction, rampant use of pesticides, and climate change.

But new research published March 30 in *Biology Letters* adds an unexpected suspect, at least for a large swath of North America: the earthworm. The study looked at 60 plots in an aspen and poplar forest in Alberta, Canada, and found that as the numbers of earthworms wriggling in the soil and leaf litter increased, the diversity and abundance of invertebrates aboveground decreased.

These results might sound surprising, since earthworms are widely considered to be helpful garden residents. Worms earned their reputation by aerating and mixing soil with their burrows and releasing locked up nutrients in their castings, all of which can help certain plants thrive. But this new study is part of a growing body of research suggesting that at least in the forests of northern North America, earthworms may not be the slimy angels of the underworld we tend to think they are.

"When people talk about insect decline, they rarely talk about the soil," says Nico Eisenhauer, a soil ecologist at Leipzig University in Germany and one of the authors of the new study. "Many of the insects and invertebrates that are in decline have life phases in the soil. What you don't see flying around now has first disappeared from the soil, and earthworms can fundamentally alter soil conditions."

Underground invaders

Earthworms' subterranean engineering isn't a problem in their native ecosystems, but in the northern half of North America, the glaciers of the last ice age wiped out virtually all soil-dwelling worms more than 10,000 years ago. The ice sheets covered nearly all of Canada, most of the northeast U.S., and much of the upper Midwest. When the ice receded, forests returned but the worms did not because they can only expand their range by a maximum of about 30 feet a year. These northerly ecosystems evolved for millennia in the absence of earthworms.

Without worms munching through fallen foliage and churning the soil, these forests accumulated thick layers of leaf litter, which came to support a vast array of animals, fungi, and plants. Eisenhauer says even non-scientists can appreciate the difference.

"Walking in forests that haven't been invaded by earthworms, the ground feels fluffy under your feet," says Eisenhauer. "It's because you're walking on a carpet of thick organic matter that has formed over thousands of years."

But in the last several hundred years humans have intentionally and unintentionally reintroduced earthworms to many of these lands. The reintroductions have mostly been European worms brought over intentionally by settlers or unintentionally in shipments, plants, livestock, or ship ballasts (often soil or rocks were used as counterweights

in cargo ships). Nowadays, introductions come from fishing bait, imported soil and plants, or even the soles of hiking boots and mountain bike tires which can trap the worms' tiny cocooned eggs.

Prior research has shown that in northern North America the introduction of non-native earthworms can **reduce plant diversity** including some species of **wild orchids**. A pair of studies have also shown negative impacts on certain **ground nesting birds** and even some **salamanders**, both of which spend time in the leaf litter layer that invading worms tend to devour.

The worms' relentless tunneling, feeding, and pooping changes the physical, chemical, and biological properties of the soil, reshuffling the ecological deck in ways native species are not always able to cope with.

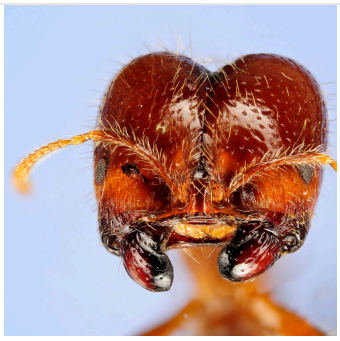
From the ground up

But not much research has examined earthworms' impact on aboveground arthropods.

To study this, Eisenhauer and **Malte Jochum**, a postdoc in Eisenhauer's lab and the paper's lead author, conducted biological surveys in the forests surrounding a reservoir called Barrier Lake about 40 miles west of Calgary in Canada in the summer of 2019.

Amid the forest's trembling aspens and balsam poplars, the scientists set up 60 roughly three-foot by three-foot plots. To get a rough earthworm count for each plot the team dug up the first four inches of soil and then doused the small pit with a mixture of water and mustard powder. This solution irritates the worms' skin without harming them and sends them writhing to the surface to be counted.

After classifying each plot as having low, medium, or high numbers of invasive earthworms, Jochum and others moved in to collect surface-dwelling invertebrates. This involved using a backpack-mounted vacuum to suck up all the invertebrates.



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"You look a bit like you're dressed up as one of the Ghostbusters," Jochum says.

Jochum and his colleagues collected and classified some 13,000 invertebrates and found striking declines in the plots with the most earthworms. Among these aboveground invertebrates, the team found there were 18 percent fewer species, a 27 percent reduction in overall biomass (or weight), and a 61 percent decline in the number of individuals at sites they classified as having high densities of invasive earthworms, compared to sites with the lowest densities of worms.

The results were surprising, Eisenhauer says. The study "shows how much aboveground communities depend on the soil and how big an impact underground invasive species can have."

The researchers say more work is needed to pinpoint how the worms are driving this decline, but that the main factor is likely to be the worms eliminating the leaf litter layer from the forest floor.

"Anything that lives in that layer or depends on it for food will be negatively impacted," Eisenhauer says.

Jochum says that losing all these mostly tiny animals matters a great deal to the rest of the ecosystem because of what invertebrates do.

“They are food for other larger animals and they perform key ecosystem functions like pest control, herbivory, and decomposition,” Jochum says.

But people don’t need to evict worms from their gardens, says **Erin Cameron**, a soil ecologist at Saint Mary’s University in Canada who wasn’t involved in the study.

“People should think of earthworms as potentially negative in native forests but fine in your gardens,” Cameron says. “If you live in a remote area, I wouldn’t add earthworms to your yard, but they’ve been established in cities for a long time and there actually isn’t any good way to remove them.”

Instead, the key is to prevent spreading them further. Fishers can help by avoiding using worms as bait in areas they don’t belong—much of the Northeast U.S., Upper Midwest, and Canada—or by not dumping unused bait in forests, says Eisenhauer. Hikers can wash their shoe soles before setting off into remote woods. Unfortunately, warming temperatures could allow worms to spread further north as soils warm up.

Eisenhauer and others say more work is needed to figure out how broadly these results might apply elsewhere. Cameron, for example, questioned whether forests dominated by conifers would see such severe invertebrate declines, since their soils and leaf litter don’t seem to be quite as appetizing to the creepy crawlers. It’s also not entirely clear how much of northern North America has been invaded by earthworms. (There are likely patches of relatively pristine deciduous forest scattered through New England and the upper Midwest that could be ripe for earthworm invasion.)

“Even if this is just a phenomenon in broadleaf forests [without conifers], that still impacts huge parts of North America,” says **Bruce Snyder**, who studies invasive earthworms at Georgia College and State University and wasn’t part of the study. If these effects are happening throughout the range of nonnative worms, the impacts are “probably quite widespread and they should be taken seriously.”

Annise Dobson, a soil ecologist at Yale University, is one who takes such effects seriously. “I feel very worried about earthworm invasions,” she says.

Dobson spends her days documenting the newest wave of invasive worms, which hail from Asia and are known as jumping worms for their characteristic thrashing. They’ve only been found in a few isolated locations in Canada but Dobson says they’re marching up the U.S. East Coast and their impacts might be similar but even more intense than their European antecedents.

“Earthworms are moving across North America without us seeing them, so people aren’t that aware, and this study shows that the impacts can be huge.”

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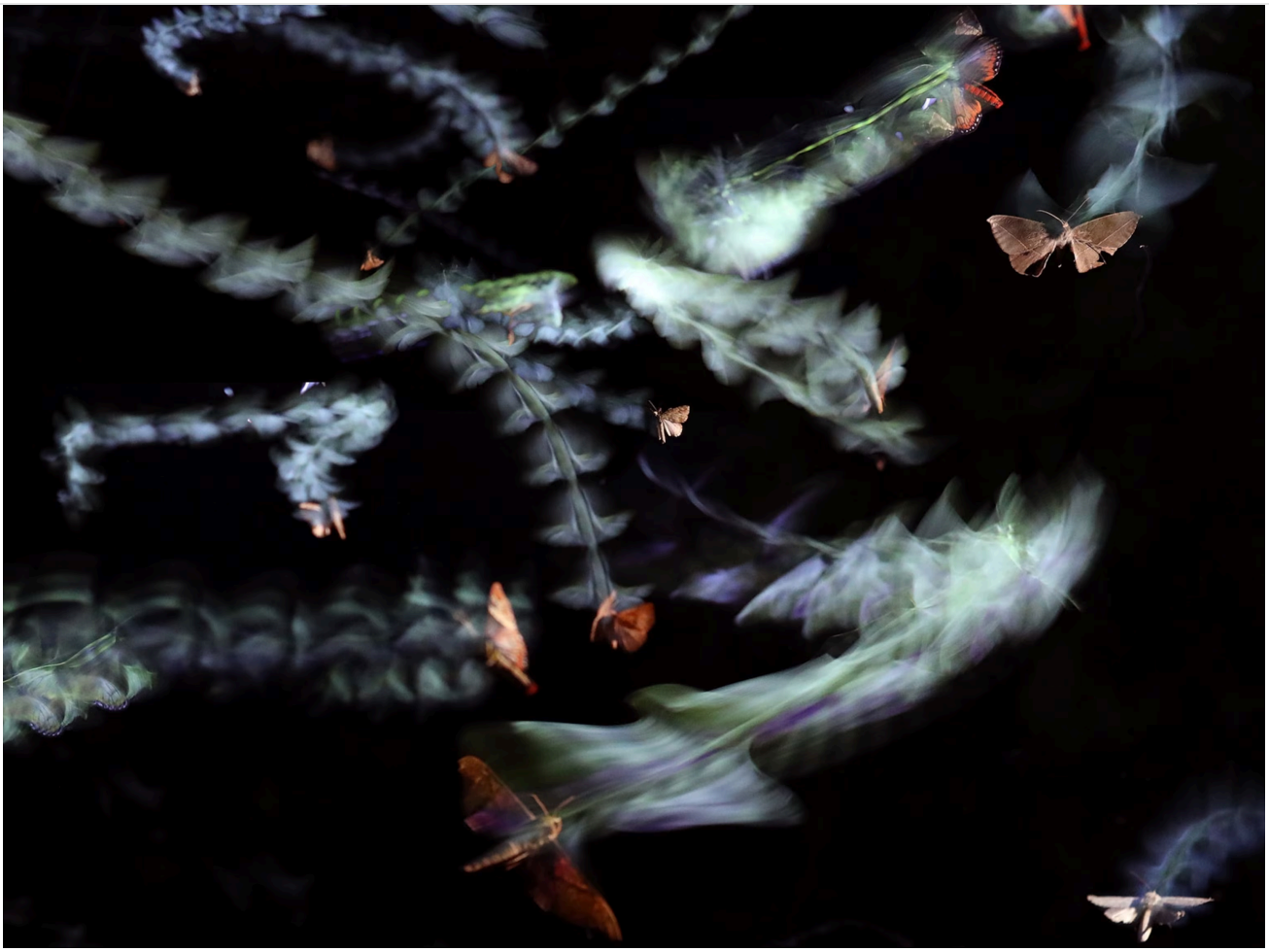

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