

European earthworms decrease species diversity in North America

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Earthworms of the species *Lumbricus terrestris*. Credit: Simone Cesarz (iDiv)

European earthworms are responsible for the decline in species diversity in North American Forests. Scientists from the German Centre for Integrative Biodiversity Research (iDiv) and the Leipzig University,

together with colleagues from the United States and Canada have now been able to demonstrate this pattern for the first time. The introduced worms are invading the forests of North America. With dire consequences, as the researchers have reported in the journal *Global Change Biology*, because the vegetation on the forest floor has changed dramatically: The species diversity of native plants is declining, yet the amount of non-native (exotic) plants is increasing, and so is the amount of grasses.

In Europe, they are classified as beneficial organisms, but many North American ecosystems are not adapted to these subterranean burrowers. This is because almost all earthworms became extinct there during the last ice age, which ended about 12,000 years ago. When the ice retreated, new ecosystems that are adapted to soils without earthworms emerged. But by now, several earthworm species live again in North America. They were introduced by European settlers and spread by anglers. An earthworm invasion is making its way through the forests at approximately five metres per year and is altering the physical and chemical properties of soils. Earthworms mix soils and build extensive burrows, which interrupts the symbiotic relationship between plants and fungi (mycorrhiza). The mixing also affects soil pH: the best-known earthworm in central Europe, the *Lumbricus terrestris*, carries alkaline soil upwards from deeper layers. On the [forest floor](#), the leaf litter vanishes as it is eaten up by the worms and turned into humus. As a result, the nutrients stored in the leaves become quickly available to the plants. Furthermore, the soils dry out easily as water drains away readily.

Many [native plants](#) cannot thrive under these unusual circumstances, which is why the [species diversity](#) of the forest understory is decreasing. Wherever the worm creeps, the goblin fern (*Botrychium mormo*), for example, has become rare. Other plants are also threatened by the earthworm invasion, such as the largeflower bellwort (*Uvularia grandiflora*), the Japanese angelica tree (*Aralia elata*), the forest lily

(*Trillium* spp.), the Solomon's seal (*Polygonatum* spp.) or the tormentil (*Potentilla erecta*). Conversely, the worms literally prepare the soil for non-native (exotic) plants, which are used to living with earthworms. Grasses also grow well in invaded forests because their fine roots can quickly absorb soil nutrients, particularly nitrogen, and can tolerate summer droughts. Moreover, earthworms eat small seeds of certain plant species and thus directly influence the composition of the forest understory. Because earthworms live in different soil layers and their effects are cumulative, the more types of earthworms that live together in one location, the more plant species vanish.



Poor understory vegetation in forest invaded by earthworms. Credit: Scott L. Loss (Oklahoma State University)

The researchers have brought together and evaluated data from 14 studies and published their findings in the journal *Global Change Biology*. Their results demonstrate, for the first time, a general pattern between the decline in species diversity in North American forests and the spread of European [earthworms](#). 'The earthworm invasion has altered the biodiversity and possibly functioning of the forest ecosystems, because it affects the entire food web as well as water and nutrient cycles', says Dylan Craven, lead author of the study. 'The long-term impact could be massive and be exacerbated further still by climate change', adds director of studies, Professor Nico Eisenhauer. Both are scientists at the German Centre for Integrative Biodiversity Research (iDiv) and at the Leipzig University and have conducted their study together with colleagues from the United States and Canada. Eisenhauer had recently raised 1.5 million euros in funding from the EU to investigate the consequences of the earthworm invasion.



Rich understory vegetation in forest with no earthworms. Credit: Paul Ojanen (University of Minnesota)

More information: Dylan Craven et al, The unseen invaders: introduced earthworms as drivers of change in plant communities in North American forests (a meta-analysis), *Global Change Biology* (2016). [DOI: 10.1111/gcb.13446](https://doi.org/10.1111/gcb.13446)

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