# Caterpillars listen to voicemail by eating soil

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Credit: NIOO-KNAW

Leaf-eating caterpillars greatly enrich their intestinal flora by eating soil. Even effects of plants that previously grew in that soil can be found back in bacteria and fungi in caterpillars. Researchers from the Netherlands

Institute of Ecology (NIOO-KNAW) and Leiden University write about this discovery in *Nature Communications*.

Do caterpillars play doctor? Perhaps. In any case, they do display similarities with human children. "Children sometimes put soil in their mouths. It is assumed that this helps their immune system. It now seems that caterpillars do the same," says Martijn Bezemer, Professor of Ecology of Plant-Microbe-Insect Interactions at Leiden University and researcher at the Netherlands Institute of Ecology (NIOO-KNAW).

## Plant telephones and voicemails

Earlier research by NIOO indicated that plants, acting much like telephones, transmit information between insects above and below ground. In addition, soil can also store these messages, like voicemails which can later be listened again. In a new study, a team of four ecologists have now discovered that above-ground insects such as caterpillars can retrieve this voicemail from the ground themselves, without the intervention of plants.

Bezemer and NIOO colleagues Emilia Hannula, Feng Zhu, Robin Heinen studied the microbiological composition, or the microbiome: a layer of micro-organisms that lives on almost every surface, from grains of sand and roots to leaves, teeth and intestines. Microbial ecologist Hannula explains: "We found that the composition of the microbiome in the caterpillar intestines is astonishingly similar to that of the soil: there was a 75% overlap." That was a surprise, she adds; she had expected that the microbiome on the plant would be most related to that in the herbivorous insect.

Credit: NIOO-KNAW

The soil used in the study was retrieved from field trials in the Veluwe, containing different types of herbs and grasses. Differences in growth type and speed between these plants also appeared to cause differences in soil bacteria and fungi, which was conformed in a greenhouse experiment. The researchers state that is the first evidence that such 'inheritances' in the soil can affect the microbiome of insects in this way.

"If they get the chance, caterpillars search the ground for food," Heinen observed. If the caterpillars only received cut leaves of one single species (dandelions) as a meal and were not able to search the the ground, their gut flora turned out much simpler and three times less diverse. In fact, its

composition much more resembled the micro-organisms on the leaves.

"I think this is very important knowledge for farmers and growers," says Bezemer. "Soil history can be found not only in plants, but also in insect life. For example, in controlling pests you will have to take in account the soil in which you work." If in good condition, the biodiverse soil life can contribute greatly to pest control and food for healthy crops and species-rich nature.

**More information:** Foliar-feeding insects acquire microbiomes from the soil rather than the host plant, DOI: 10.1038/s41467-019-09284-w , www.nature.com/articles/s41467-019-09284-w

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