THE WORMS ARE COMING! THE WORMS ARE COMING!

(too late, they're already here)

How invasive earthworm species are altering the fungal makeup of North American soils and plant communities.

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Okay, all annelidical (and analytical) joking aside, nonnative worms are nothing to be taken lightly. They are altering the environment and they're here to stay (for a great review, see Hendrix, 2006). Furthermore, most people don't realize that pretty much *any earthworm you find in the soil is nonnative*. Our native ones, as I understand it (and I'm no authority on worms) are all pretty puny things so any decent sized worm, e.g. redworm or nightcrawler is an invasive. It's amazing to think how recently they've come to North America ... how relatively slowly they move through soil and yet how widespread they are. Pretty much all the human-inhabited parts of North America now have nonnative worms. The Midwest, where I'm from, has been very heavily affected. Because the forested areas of the Midwest were once covered in glaciers, there are no native earthworm species present in the soil. And since glacial times, forest decomposition there has been a slow process involving fungi (primarily), allowing for a buildup of a deep organic litter layer on top of the soil. Worms arrived from Europe in ship ballast dumped ashore or in soil clinging to imported plant roots (and more recently in farms growing worms as bait) and have been impacting North American forests ever since. Humans have knowingly (and unintentionally) moved the wrigglers around. And although we're becoming aware of the hazards posed to our ecosystems by invasive worms, worm farms continue to bring in new types. More on that, below.

"Worms are great for soil!" That's what you always hear, right? When I was a kid in school, that's what we learned. I just checked with my kids; story is still the same in schools today. At the local garden center or plant shop, you'll hear the same thing. Worms are a sign the soil is healthy … and they're hard at work making the soil even better for plants. They help to loosen soil and facilitate better soil aeration and drainage. Everyone knows that. And oh those castings they leave behind! That stuff's like gold for the soil, right? (It's considered so valuable that garden centers often sell it—at exorbitant prices—bagged and ready to go. I've often wondered how it's collected… But I'm getting off topic.)

All of this is true. Or mostly so. Worms do benefit plants in agricultural or garden settings. But in native habitats, like our forests, which never had these big, aggressive newcomers it is a much different story. The problem with worms is not what they do to soil, it's what they eat. Firstly, they don't really eat soil. (My kids also informed me that they had learned that worms eat soil.) Earthworms eat organic matter like leaves. In general, worms hang out in their burrows and come out—above the soil layer—to feed on organic debris in the humus layer on debris that collects anywhere on the soil surface. In fact, invasive worms are so numerous (and voracious) in many forests now that there no longer is a humus layer. They've consumed it all! And this is becoming devastating to native plants that are adapted to deep, rich humus which holds in moisture, and affords protection from cold and winds to roots, delicate shoots and seedlings. The result is that plant communities are being altered by invasive worms.

Affects to animals in the community

We are beginning to see signs that in worm-altered plant communities, the animal diversity there can be impacted as well. Exclusion of some plants will undoubtedly impact some sensitive species like amphibians reliant on plant (and humus) cover for protection from sunlight and drying, as well as predation. And birds are being affected too. A recent survey conducted in Minnesota's Chippewa National Forest and Wisconsin's Chequamegon-Nicolet National Forest by a research team led by Scott Loss of the University of Minnesota and the Smithsonian Migratory Bird Center has revealed a direct link between the presence of invasive European earthworms (*Lumbricus* spp.) and reduced numbers of ovenbirds (*Seiurus aurocapilla*) in mixed sugar maple and basswood forests (Loss et al., 2012). As a result of loss of the humus layer to hungry worms, herbaceous plants that thrive in thick leaf litter and provide cover for ground-nesting birds are thinning out, and are being replaced by grasses and sedges. The researchers found that ovenbird nests are more visible and vulnerable to predators in these areas; and ovenbirds searching for nesting sites reject these low-cover areas outright and migrate elsewhere. Areas of reduced leaf litter also contain diminished food insects for the ovenbirds to eat, requiring them to establish larger territories, resulting in fewer birds over a given area.

Affects to fungi in the community

A number of studies have found that an earthworm invasion can alter the abundance and structure of soil fungal communities (Johnson et al. 1992; McLean and Parkinson, 1998; McLean and Parkinson, 2000; Lawrence et al., 2003). Specific findings include: reduced densities and community composition of soil microfungi directly linked to the exotic earthworm, *Dendrobaena octaedra*; while, seemingly paradoxically, the activity of invasive worm species sometimes favor faster-growing fungal taxa at the expense of slower-growing taxa. Focusing on mycorrhizal (plant symbiotic) fungi, invasion by the exotic earthworms *Lumbricus rubellus*, *L. terrestris*, and *Octolasion tyrteum* were correlated with reductions in colonization by arbuscular mycorrhizal fungi on sugar maple (*Acer saccharum*) (Lawrence et al., 2003). Physical disruption of mycelia and responses to increased nutrient availability due to earthworm activity were two mechanisms suggested to explain mycorrhizal suppression by earthworms in their paper.

Invasive worms seem to reduce the diversity of native plants too, and possibly by altering the composition of the fungal community (we are beginning to see documentation of this with other invasives like garlic mustard which excludes many types of soil fungi that are symbiotic partners with native plant species).

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More bad news from the world of invasive worms!

A still newer annelid threat is heading your way: the Asian crazy worm! Also known as jumping worms, snake worms, and Alabama jumpers,* Amynthas agrestis*, is the newest and possibly most alarming invasive worm species to hit North America. While they've been established on the East Coast for a few decades, this most aggressive of all earthworms has only very recently turned up in the Midwest, signaling that they're spreading even more rapidly than any other invasive worm. And there is much to fear. This worm is much more active (you can see videos of them online—they behave like a captured snake, rapidly wriggling free of any container or human hand in seconds), have a more voracious appetite than any other known worm, and have a very short life cycle, maturing in just 60 days. And they reproduce like … well, like crazy!