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Gale E. Ridge, Ph.D.
Department of Entomology
The Connecticut Agricultural Experiment Station
123 Huntington Street
New Haven, CT 06511
Phone: (203) 974-8600
Fax: (203) 974-8502
Email: gale.ridge@ct.gov
Website: https://portal.ct.gov/caes

Jumping Worms (Megascolecidae: Pheretima) in Connecticut

What are jumping worms?

Introduction

There are three species of concern: the rustic jumping worm, *Amynthas agrestis,* the compact jumping worm, *Amynthas tokioensis,* and the large jumping worm, *Metaphire hilgendorfi*, in the family Megascolecidae. Jumping worms may also be called crazy worms, crazy snake worms, Georgia or Alabama jumpers, Jersey wigglers, wood alves, or sharks of the earth. They were introduced from East Asia, principally from Japan. One of the first records of their introduction was the Bronx Zoo, New York. Jumping worms were imported to the Bronx Zoo in 1948 to feed Australian platypuses. More recently, they were rapidly spread in New York following Hurricane Sandy through the chipping of downed trees and movement of soil and mulch for biofuel and landfill cover.

Jumping worms are noticeably fast-moving, highly active worms with a strong, rigid, muscular body that can thrash violently when disturbed. Although they are highly active and good at climbing, jumping worms do not jump. They possess a high hydrostatic body pressure, which makes them snake-like. Unlike European earthworms, jumping worm tails do not flatten when they move. These are earthworms on steroids!

Research shows they are displacing and outcompeting European earthworms. The combination of jumping worms, deer browse, and invasive plants is conspiring to destabilize native ecosystems and threaten native flora and fauna species. In their native range, jumping worms are naturally controlled through predation and less nutritious food.

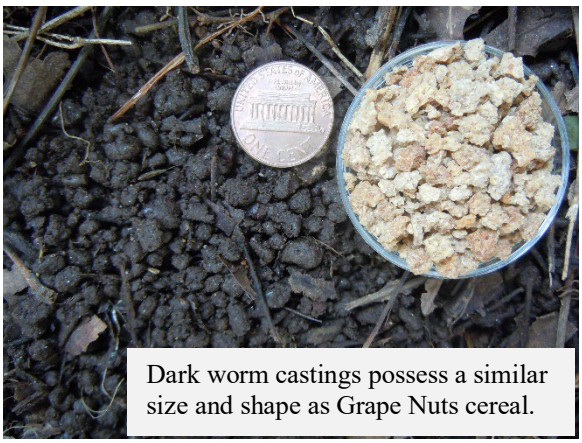
Description

A key characteristic in the identification of jumping worms is the appearance of the clitellum, or collar, behind the head in mature adults. The clitellum in jumping worms is not raised. It is smooth, flat, and milky-white (cream-colored) pale pink, and completely circles the body. In nightcrawlers and other European earthworms, the clitellum is raised, pink, and does not circle the body but lies as a saddle. Additionally, the jumping worm's clitellum is closer to the head than in European earthworms. Juvenile jumping worms do not possess a clitellum.

The body color of jumping worms is gray, brown, or purple with a metallic sheen in older, mature worms. They are darker on top and lighter underneath.

The soil

Jumping worms alter the composition of the topsoil by homogenizing the top mineral layer and natural organic layers (organic or O horizon) of the soil, transforming leaf litter, soil fungi, and normal soil structure into a loose black layer of worm castings. Their castings (feces) are coarse, dark, and granular, similar in size and shape to Grape Nuts cereal. Their feces have also been described as looking similar to taco ground meat but blacker. They destroy the organic (O) horizon, germination medium, natural seed banks, and mycorrhizal fungus networks. These modifications depress seed storage germination and native plant root development, resulting in a collapse of understory vegetation. They destabilize the soil, increase nutrient leaching and erosion, increase drought vulnerability, cause turf detachment from the soil and unstable rooting, root desiccation, and low germination. Their activity has toppled stone walls in New England. Many native trees and plants (including garden plants) cannot germinate or develop in this altered soil, while invasive species thrive. They may threaten the maple syrup industry since sugar maples cannot germinate in jumping worm-altered soils.



Dark worm castings possess a similar size and shape as Grape Nuts cereal.

Jumping worms prefer sandy loam soils along water courses but can be found in any textured soil. They prefer moist but not wet soils and are found in areas with leaf litter rather than grass or under conifer trees.

Jumping worms increase greenhouse gas emissions from the soil by 50% over worm-free controls and 25% more than European earthworms. Combined with whitetail deer, there can be complete local plant extinctions. Soil animal communities also disappear. Ground-nesting birds, native millipedes, and salamanders are all negatively impacted.

Protective properties of castings
The layer of castings they produce protects the eggs and worms from temperature extremes and from fire or sudden, unexpected cold. Due to this temperature-moderating effect, hatchlings can remain close to the surface to feed.

Geography
The climate in the eastern half of the United States and parts of Canada is similar to that of Japan, where jumping worms are from. Jumping worms are well adapted to these humid continental and subtropical climates, which means there is a strong potential for them to invade the entire eastern half of the United States and eastern Canada.

Leaf litter
Leaf litter in the eastern US is dominated by maple leaf litter, while Japan has evergreen and oak. This means leaf litter in the US is more nutritious for the jumping worms.

Bioaccumulation of toxic metals
Jumping worms can bioaccumulate toxic metals, particularly mercury, cadmium, copper, and lead. Research has shown that sequestered heavy metals in soils have been brought back into circulation by jumping worms. Soils that have these toxic metals can be consumed by worms and bioaccumulate in their bodies up to potentially hazardous concentrations. There is a concern that there may be a negative impact on birds that feed on them. Where there are elevated levels of heavy metals in the soil, researchers suggest chickens and other domestic fowl should not be allowed to feed on these worms. Have your soil tested if this is not known.

Climbing
Jumping worms are excellent climbers. Anecdotal reports describe jumping worms being found on the upper floors of buildings. If you put a jumping worm into a bucket without drowning it in soapy water, never assume it will stay there!

Life Cycle
Jumping worms live for one year. They range from 1.5” to 8” (3.8–20.3cm) in length. In spring, juvenile worms hatch from overwintered cocoons the size of poppy seeds. Population densities of juvenile worms can be very high, with as many as 330 worms/m² (31 per square foot). Numbers decline during the summer due to competition. From mid-September to October, there are mostly adults. It takes between 60 and 90 days for worms to mature. There is concern that climate change may promote two generations per year.

Cocoons are present from November to April. They are 0.04” to 0.19” (1-3mm) in diameter and look like particles of soil. A worm can produce up to 60 cocoons in a lifetime. One to two eggs are in each cocoon. To overwinter, cocoons dehydrate to prevent freezing of the embryos. In the spring, they rehydrate, and the embryos continue to develop. They hatch when the soil temperature reaches a constant 50°F (10°C). Cocoons are ready to hatch at any time and can survive for several years, creating a cocoon bank that would require efforts over multiple years to control.

Juvenile worms are active during May and June.

Adults are active from July to October. They are killed by the first hard frosts.

Reproduction
Jumping worm populations are mostly females and reproduction occurs without mating (parthenogenesis). On occasions males are found because these particular worms possess male pores.

Distribution
Jumping worms are established in Midwestern states and are currently spreading throughout New England. In addition, they have been recently discovered in parts of southern and eastern Canada.

How are they spread?
Jumping worms are spread in soil, mulch (a principal means of distribution), compost, and yard waste. They are also spread by building and landscaping vehicles, tools, tires and boot treads as well as along waterways through sport fishing as fish. Recent research has found high jumping worm populations around boat launches, with a natural distribution from these launches of 50+ feet per year.

Indicators of jumping worms
The worms, when picked up or disturbed, are highly active and thrash in snake-like movements. Some will break off their tails to avoid perceived harm. They favor leaf litter and/or mulch. Distinctive large, globular, dark castings (feces) uniformly cover the ground. Unexplained loss of garden plantings, or understory plants, and young trees in forests. They also cause damage to vegetable crops, as seen here with potatoes.

Potato on left, healthy. Potato on right with worm puncture wound damage.

Potato on left exhibiting interior rot and worm tunnelling. Potato on right with severe damage.

Control

Identifying jumping worms
Use apps. such as

- iNaturalist
- iMapInvasives or
- EDDMaps

to identify the worms. Also, see the key to identifying three common species of Asian jumping worm at the end of this factsheet.

Prevention
Jumping worms are being distributed in pots. Buy plants with bare roots, not in pots. If suspicious, wash root systems at home. Dispose of soil in the trash.

Avoid plant exchanges or sales.

Nursery staff should watch for worms. If found, remove plants from infested soil, wash roots, and replant in clean soil. Heat-treat infested soil to kill all stages of the worms.

Propagate plants at home from seeds or cuttings.

Do not share potted plants unless you are certain there are no jumping worms or wash plant roots before sharing.

Make your own compost.

Avoid purchasing compost unless the seller can prove the compost has been heat-treated between 105°F and 131°F (40-55°C) for at least three days and there's no opportunity for trapped worms to flee to cooler areas of a compost pile during treatment.

Avoid purchasing mulch unless similar precautions have been taken.

Pay attention when bringing soil onto property. Worms, particularly juveniles and/or cocoons, can be easily introduced.

Do not buy worms for fish bait or vermicomposting unless certain jumping worms are not present.

Do not use jumping worms as fish bait in remote natural habitats. They do not stay on hooks, and fish don't like them. Never discard unused bait worms on the ground or in the water following fishing. Dispose of them properly.

Some outlets and sites on the internet sell composting worm cultures that may be contaminated with jumping worms. Be cautious purchasing these composting worm cultures unless you've checked them.

Avoid moving dead wood or wood mulch. Worms have been found under the bark of dead trees.

Do not dump infested yard waste into natural areas.

Note: New York State Regulation Part 575 (2014) regulates Asian jumping worms with warnings and fines up to $600 for public or nursery violations.

Chemicals

Currently, there are no well-established, proven methods for control or pesticides registered for use against jumping worms. Control of jumping worms is a relatively new area of research. Due diligence to prevent their spread is the best control method.

Tillage/Rototilling

Jumping worms live mostly in the top 2 inches of the soil. By rototilling before May 30th (Memorial Day) but after May 15th in Connecticut, many juvenile worms can be killed. Further north in New England, the timing for rototilling would be later in mid-June. Tilling in October is ineffective because cocoons have already been produced.

Mustard

Mustard is an irritant that can be used to effectively flush worms out of the soil. This makes detection and hand-picking easier.
Mix ⅓ cup of ground yellow mustard seed into 1 gallon of water and pour half of the liquid slowly over 1 square foot of soil. It irritates the worms, and they surface. Mustard will not harm plants.

See notes on hand-picking worms and disposal below.

Hammerhead worm. Photo: Kerstin Calia

Predators

A species of hammerhead worm, *Bipalium adventitium,* is a known general predator of earthworms. *B. adventitium* is an exotic land planarian accidentally introduced during the last century from Southeast Asia, and it is present in Connecticut. It evolved to hunt Asian jumping worms and is an active worm hunter. The markings are yellow/tan with a medial dark dorsal stripe. The head is fan-shaped. It tracks the mucus and other secretions of a worm, then wraps itself around the prey while piercing the worm with its everted pharynx. These planarians can tackle prey 55 times larger than themselves. There is evidence they use tetrodotoxin to subdue their prey. Anecdotal conversations with researchers in New England and public submissions of this particular planarian to the CAES Insect Information Office reveal a noticeable increase in their populations. This may reflect the prey-predator dynamic, where higher numbers of prey promote an increase in predator activity.

Some species of native salamanders are known predators of earthworms, as are toads, snakes, weasels, rats, moles, pigs, raccoons, American robins, woodcocks, ants, cluster flies, centipedes, ground beetles, and mites. Organisms that are known to infect earthworms include bacteria, protozoa, rotifers, platyhelminths, fungi, and a recently discovered nematode in the genus *Phasmarhabditis*. Since the jumping worm is a relatively recent introduction to the US, new pathogens may be found that are effective against it.

Fungi

Research has shown that the entomopathogenic fungus *Beauvaria bassiana* (BotaniGard ES) in pure culture on millet kills up to 80% of the worms in greenhouses. Plants are not affected by these fungi. *Metarhizium brunneum* also shows promise. Currently, *B. bassiana* and *M. brunneum* are not registered for use against jumping worms, so they should not be used at this time.

Parasites

Recent research has found that a new species of pearl parasite (gregarine protist), *Stomatocystis goerresi,* can infect one species of jumping worm, *Amynthas tokioensis*. This research is ongoing.

Hand-picking

Jumping worms are always close to the soil surface and are often found around partly buried stones and plant root systems. Rake, hoe, or hand disturb the soil surface and collect fleeing worms as they emerge. Drown them in a bucket of soapy water, or bag them and place them in the hot sun for 10 minutes. Discard in the trash. Do not throw what you think are dead worms back onto the property. Some may be stunned, recover, and continue to reproduce. Additionally, cocoons formed inside dead

worms may survive. If you do not have a container or bag at hand, throw the worms into the center of a hot, sunny driveway or road to kill them.

Solarization.
Cocoons and worms do not survive temperatures that exceed 105°F.

Use a cheap clear plastic painter's drop cloth to make a solarization package.

On any sunny day from May to September, lay out 10-15 feet of plastic in a sunny location.

Pile compost, soil, or mulch onto a plastic sheet, keeping an even depth of 6-8 inches. Make sure the compost, soil, or mulch does not reach the edge of the plastic. Leave about 8" of open plastic around the outer edge for folding.

Lay a second sheet of plastic over the pile and make sure there is plenty of extra plastic beyond the size of the pile.

Tuck the top sheet of plastic under the outer edges of the pile. Then bring up the bottom sheet edges over the top sheet and secure with duct tape or small weights such as stones; this traps escaping worms. A package like this in full sun will reach temperatures of up to 150°F, killing all stages of the worms. Leave for three (3) days.

Biochar or diatomaceous earth.
These materials incorporated into earthworm-infested soil may harm and possibly kill a few worms, but neither method has the potential to control jumping worm populations. They do harm to plants.

Saponin
Researchers are exploring the efficacy of saponin (a fat-soluble extract). It is an irritant and harms worm mucus membranes. Saponin is toxic to fish but possesses little to no residual life.
Please note: No saponin products have been registered for use against jumping worms by the EPA.

Vinegar
Worms can be killed in vinegar at 1:10 or 1:20 concentrations, but it can also kill plants.

Dish soap
Dish soap at low concentrations (one to two spritzes per 5 gallon) kills the worms but also slows the growth of plants and can cause leaf necrosis. Horticultural soap does not kill the worms and harms plants when applied to the soil.

Buying mulch or compost
If you are concerned about jumping worms in your purchased mulch or compost, spread out on a driveway, preferably on a hot day, and hand pick. Heat stress harms the worms, so consider solarization.

Soil organic content
Reduced organic matter in soils creates a harsher environment for the worms. They may not thrive as well.

Plant resilience
Deep-rooted plants can tolerate jumping worm infestations. Pollinator or prairie gardens that are deeply rooted not only provide healthy habitats for birds, insects, and animals but are also resilient to jumping worm infestations. Plants such as native partridgeberry, Jack in the pulpit, Christmas ferns, and trout lilies are all resilient plants.

References

Fact Sheets - Earthworms | Center for Agriculture, Food, and the Environment at UMass Amherst

Dobson, A., Richardson, J., and Blossey, B. (2019). Effects of earthworms and white-tailed deer on roots, arbuscular mycorrhizae, and forest seedling performance. *Ecol. 101*(1). DOI: 10.1002/ecy.2903

Frelich, L. E., Blossey, B. et al. (2019). Side-swiped: Ecological cascades emanating from earthworm invasion. *Front. Ecol. Environ. 17*(9), 502-510. DOI: 10.1002/fee.2099

Görres, J. H., Martin, C., Nouri-Aiin, M., and Bellitürk, K. (2019). Physical properties of soils altered by invasive pheretimoid earthworms: does their casting layer create thermal refuges? *Soil Systems, 3*(3), 52.

Nouri-Aiin M., and Görres, J. H. (2019). Earthworm cocoons: The cryptic side of invasive earthworm populations. *Appl. Soil Ecol. 141,* 54-60. DOI: 10.1016/j.apsoil.2019.05.004

Nouri-Aiin M., and Görres, J. H. (2021). Biocontrol of invasive pheretimoid earthworms using *Beauveria bassiana. PeerJ, 9.* DOI: 10.7717/peerj.11101

Schall, J. J. (2021). *Stomatocystis goerresi*, a new species of gregarine parasite (Apicomplexa, Monocystidae) from the invasive Japanese earthworm *Amynthas tokioensis* (Megascolecidae), with a description of the parasite's life cycle. *Folia Parasit. 68*, 22. DOI: 10.14411/fp.2021.022

Richardson, J. B. (2019). Trace elements in surface soil and Megascolecidae earthworms in urban forests within four land uses around Poughkeepsie, New York, USA. *Bull. Envir. Cont. and Tox. 103*, 385-390.

Stokes, A. N. et al. (2014). Confirmation and distribution of Tetrodotoxin for the first time in terrestrial invertebrates: two terrestrial flatworm species (*Bipalium adventitium* and *Bipalium kewense*). *PLOS/one*, *9*(6). DOI: 10.1371%2Fjournal.pone.0100718

Zaborski, E. (2002). Observations on feeding behavior by the terrestrial flatworm *Bipalium adventitium* (Platyhelminthes: Tricladida: Terricola) from Illinois. *The Amer. Mid. Nat. 148* (2), 401-408.

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Key to Jumping Worms in Connecticut

*Key based on work done by Dr. Josef Görres, Uni. of Vermont, USA.