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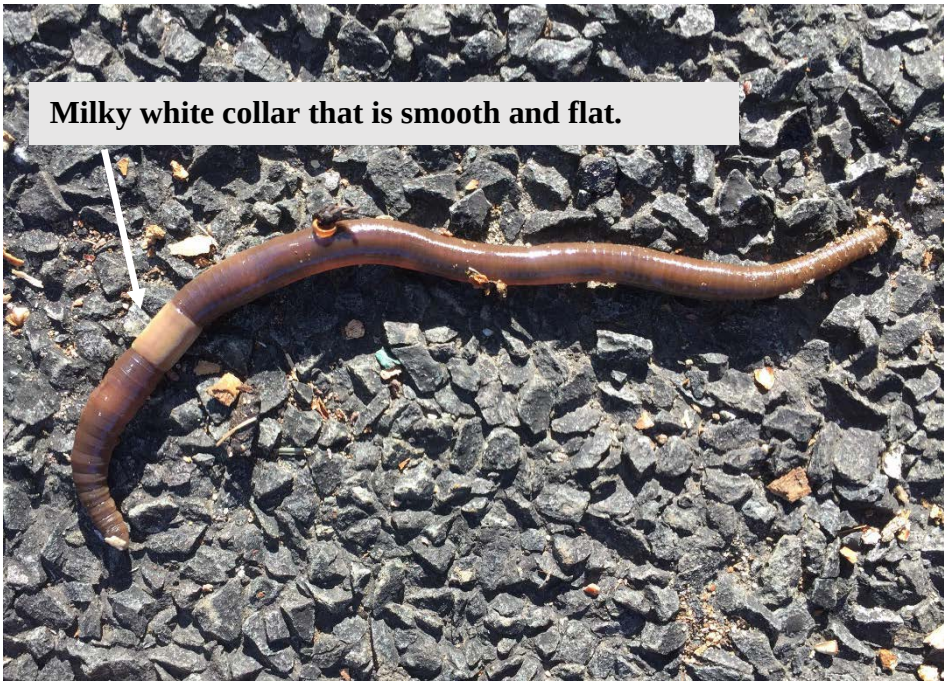
# Jumping Worms (Megascolecidae: Pheretima) in Connecticut

## 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. They were introduced from Asia, principally from Japan. They can also be called crazy worms, crazy snake worms, Georgia or Alabama jumpers, Jersey wigglers, wood alves, or sharks of the earth. One of the first records of introduction was at 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 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 whip 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!

They can displace and out compete other earthworm species. In their native range, they are naturally controlled through predation and less nutritious food.

**Description**

A key characteristic in 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) to pale pink, and it completely circles the body. In night-crawlers and other European earthworms the clitellum is raised, pink, and does not circle the body, but lies as a saddle. Additionally, the jumping worm clitellum is closer to the head than in European earthworms. Juvenile worms do not have a clitellum.

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

**The soil**

Jumping worms alter 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 like taco ground meat but blacker. They destroy the organic (O) horizon, germination medium, natural seed banks and Mycorrhizalhyphal network. Together 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 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.

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 like moist but not wet soils. They do not dig deep into the soil and are found in higher abundance in areas with leaf litter, rather than grass or conifer needles.

Jumping worms increase greenhouse gas emissions from the soil by 50% over worm-free controls and 25% more than European earthworms. Combined with white-tail deer there can be complete local plant extinctions (Dobson & Richardson, 2019). Soil animal communities also disappear. Native millipedes and salamanders are negatively impacted as well as ground nesting birds.

**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 (Görres et al., 2019). 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 are similar to the area in Japan where jumping worms come from. Jumping worms are well adapted to these humid continental and humid subtropical climates, and so they have a strong potential to invade the entire eastern half of the United States and parts of Canada.

**The 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.

**Coexistence**
Often *Amynths* and *Metaphire* worms are found together. This coexistence is likely due to resource partitioning.

**Bioaccumulation of toxic metals**
Jumping worms can bioaccumulate toxic metals, particularly mercury, cadmium and lead (Richardson 2019). This is soil dependent. If soils are high in these toxic metals, the worms can consume the metals and bioaccumulate them in their bodies at potentially hazardous concentrations, which may negatively impact birds that eat them.

Researchers suggest that chickens and other domestic fowl should not be allowed to feed on these worms where there are elevated levels of heavy metals in soil. Have your soil tested if this is not known. See the website of Dr. Justin B. Richardson, UMass, Amherst Dept. of Geoscience for more information.

**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" (3.8–20.3 cm) 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. By mid-September – October the population is 90% adults. It takes between 60 to 90 days for worms to mature. There is concern that climate change may promote two generations per year.

- **Adults** are active from July to October. They are killed by the first hard frosts.
- **Overwintering cocoons** are present from November to April. They are 0.04" to 0.19" (1-3 mm) in diameter and look like soil particles. One to two eggs are in each cocoon and a worm can produce up to 60 cocoons in a lifetime.
  To overwinter, cocoons dehydrate to prevent freezing of the embryos. In 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 up to 2 years, creating a cocoon bank, which would require efforts over multiple years for control (Nouri-Aiin M., & J. H. Görres, 2019).
- **Juvenile worms** are active during May and June.

**Reproduction**
It is assumed that reproduction is without mating (parthenogenesis). However, there is a large genetic diversity among the worms which could mean many different clones, or some recombination is occurring after all. Most of these earthworms have no male pores but in some rare individuals, the male pores are present.

**Distribution**
Jumping worms are established in the Midwestern states and spreading throughout New England. At the time of this writing, jumping worms have been reported throughout Connecticut.

**How are they spread?**
Jumping worms are spread in soil, mulch, compost, and yard waste, along waterways through sport fishing as fish bait, and by building and landscaping vehicles, tools, and tire and boot treads.

**Indicators of jumping worms**
The worms themselves will be highly active and whip, jump, and thrash in snake-like movements when disturbed. Some will break off their tails to avoid predators. They favor leaf litter and/or mulch.

Distinctive large globular dark castings (feces) uniformly covering the ground.

Unexplained loss of garden plantings or understory plants and young trees in forests.

# Control

**Identify jumping worms**
Use iPhones apps. such as

- iNaturalist
- iMapInvasives or
- EDDMaps

to identify the worms. Also see the key to identify three common species of Asian jumping worm on the last page of this factsheet.

**Prevention**

- Buy plants with bare roots, not in pots. Jumping worms are being distributed in potted plants. Check everything very carefully. If suspicious, wash root systems at home.
- Avoid plant exchanges or sales.
- Nursery staff should watch for worms by washing sample plant roots.
- Propagate plants yourself from seeds or cuttings
- Do not share potted plants unless you are certain there are no jumping worms or wash the roots before planting.
- Make your own compost.
- Avoid purchasing compost unless the seller can prove that the compost has been heat-treated between 105°F and 131°F (40-55°C) for at least three days and there was 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 carried in.
- Do not buy worms for fish bait or vermicomposting unless you are certain there are not jumping worms. Many outlets have composting worm cultures that are contaminated with jumping worms. Do not buy on the internet.
- Do not discard unused bait-worms on the ground or in water following fishing.
- Do not move dead wood or wood mulch. Worms have been found under the bark of dead trees.

- Do not use jumping worms as fish bait in remote natural habitats. They do not stay on the hook and fish don't like them.
- Do not dump infested yard waste in natural areas.
- **Note:** New York State Regulation Part 575 (2014) regulates against 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 spread is your 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 mid-June. Tilling in October is ineffective, because cocoons have been produced.

**Mustard**
Mustard is an irritant which can be used to 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 a 1 square foot of soil you want to test. It irritates the worms and they surface. The mustard will not harm plants.
See notes on hand-picking worms and disposal below.

**Natural predators, parasites, and biocontrols**

**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 is an active worm hunter. 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. They can tackle prey 55 times larger than themselves. There is evidence these planarians use tetrodotoxin to subdue their prey (Stokes, 2014; Zaborski, 2002). Anecdotal conversations with other researchers in New England, and public submissions of this particular planarian to the Insect Information Office (IIO) reveal a noticeable increase in their populations during the past year. This may reflect the prey/predator dynamic where higher numbers of prey promote an increase in predator activity.


Hammerhead worm. Photo: Kerstin Calia

**Fungi**
Research has shown that the entomopathogenic fungi *Beauvaria bassiana* (BotaniGard ES) in pure culture on millet kills up to 80% of the worms in greenhouses (Nouri-Aiin, M. & Görres, J. H., 2021). *Metarhizium brunneum* also shows promise. Currently, *B. bassiana* and *M. brunneum* are not registered for use against jumping worms, so must not be used at this time.

**Parasites**
Research by Schall (2021) has found that a new species of pearl parasite (gregarine protist), *Stomatocystis goerresi,* can infect one species of jumping worm, *Amynthas tokioensis* (Schall 2021). Research is ongoing.

**Hand-picking**
Jumping worms are always close to the soil surface, often around partly buried stones, and can be flushed out using a solution of mustard (see note above). Rake, hoe, or hand disturb the soil surface, then pick the worms. Drown them in a bucket of soapy water, or bag and place in the hot sun for 10 minutes, then 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. If you do not have a container or bag at hand, throw the worms into the center of a hot sunny driveway to kill them.

**Solarize to prevent invasion**
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 introduced compost, soil or mulch onto plastic sheet keeping an even depth of 6-8 inches. Make sure the compost, soil or mulch doesn't reach the edges of the plastic.
- 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.
  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 potential to control earthworm populations.

**Organic fertilizer**
Organic fertilizer made from the non-toxic tea tree seed meal irritates and slowly kills the worms. Treatment times are late April to early May through the summer.

Researchers are also exploring the efficacy of saponin (a fat-soluble extract). It is an irritant and destroys the worms' mucus membranes. Saponins are toxic to fish, possess little to no residual life and need to be watered in. *Source:*
https://www.wlsunshine.com/products/Tea_Seed_Meal.html

**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/5 gallons) 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 concerned about jumping worms in your purchased mulch or compost, spread on to a driveway preferably on a hot day and hand pick. Heat stress harms the worms. Consider solarization (See previous section on solarization).

**Soil organic content**
Reduced organic matter in soils creates a harsher environment for the worms.

**Plant resilience**
Plant deep-rooted plants that can tolerate jumping worm infestations. Pollinator or prairie gardens also provide healthy habitats for birds, insects, and animals. Plants such as native partridgeberry, Jack in the pulpit, Christmas ferns, and trout lilies are all resilient.

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This is a developing scenario and information is subject to change.

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## Key to Jumping Worms in Connecticut

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