

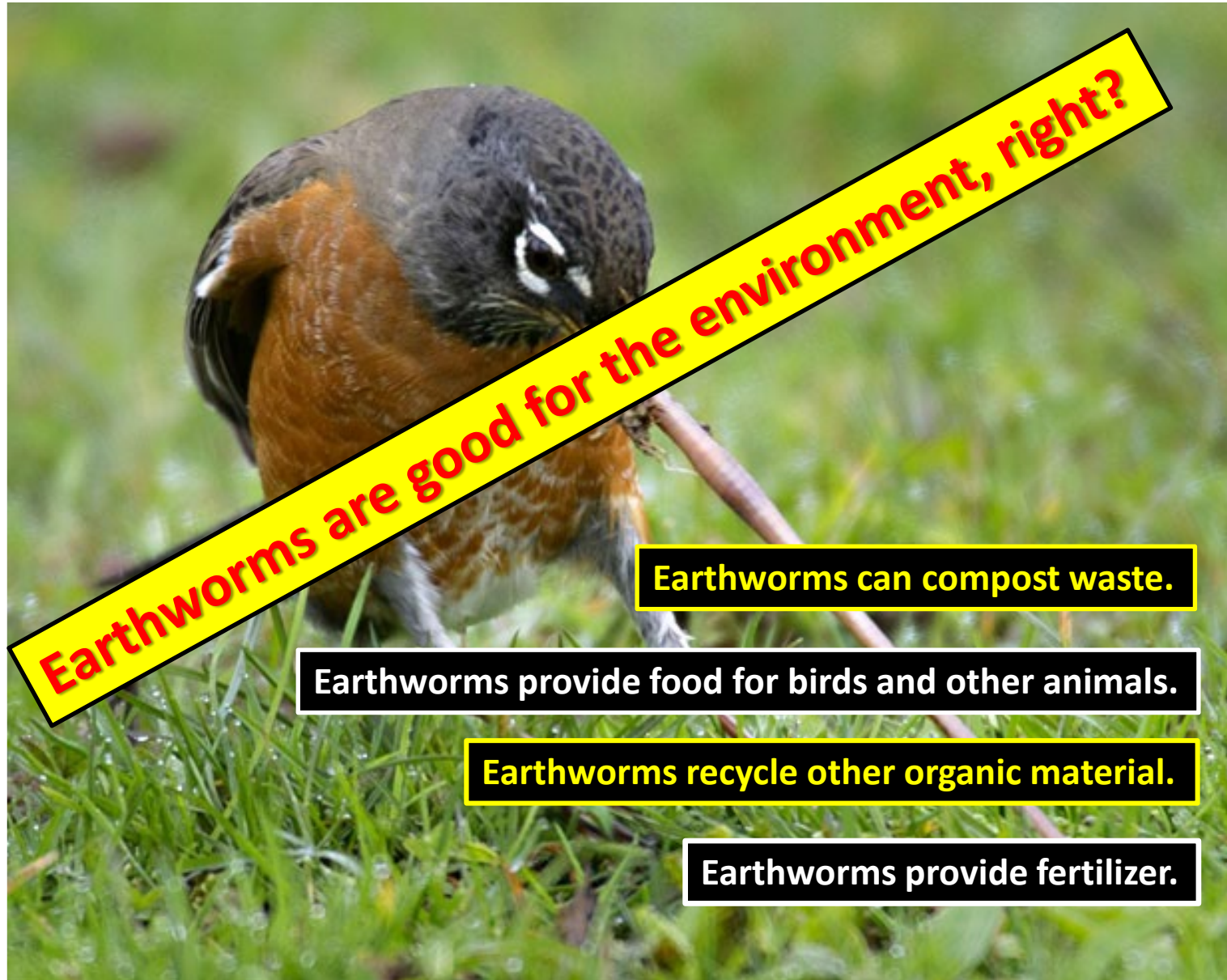


2024 Jumping Worm Update

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gary.fish@maine.gov
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Earthworms - Good for the environment?



Earthworms are good for the environment, right?

Earthworms can compost waste.

Earthworms provide food for birds and other animals.

Earthworms recycle other organic material.

Earthworms provide fertilizer.

Why you might want to reconsider how you feel about earthworms.

Earthworms are an invasive species.

Earthworms upset soil chemistry.

Earthworms make it more difficult for native plants and insects to thrive.

Earthworms can damage forests.

WHO OPENED THE CAN?



STORIES TO H

SPELLB

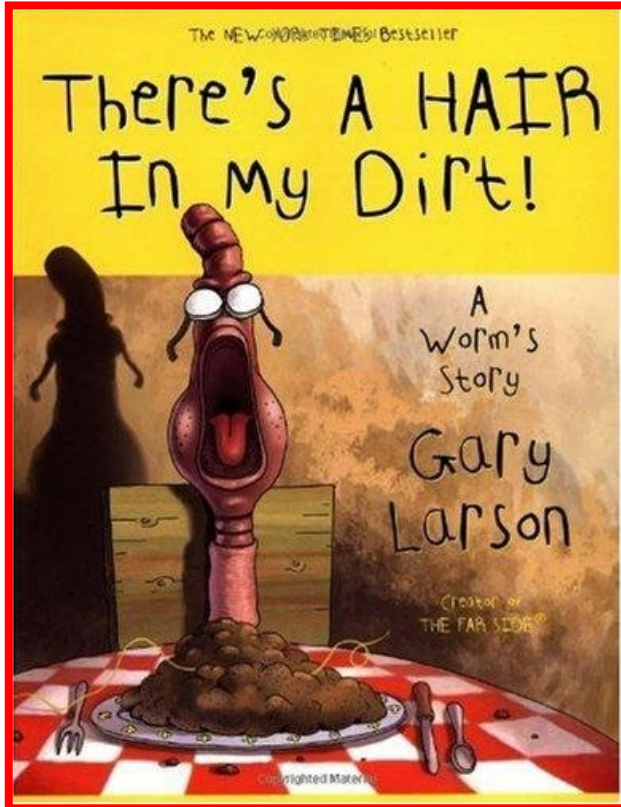
MAY

IT'S FOUND US!

IT'S THE WORM!



Earthworm Ecology



Worms eat dirt. They are detritivorous where they feed on decaying organic matter (leaf litter) and geophagous (dirt) and feed mainly in the soil layers.

Earthworms are...

- Invertebrates
- Eat decaying roots, leaves, bacteria, fungi
- Live in soils all over the world



Eisenia fetida
'red wiggler'



Aporrectodea longa
'blackhead worm'



Lumbricus terrestris
'nightcrawler'

Earthworm Biology

1. Epigeic (leaf litter 1-3")

- Ex: Red Wigglers



Red Wiggler
Eisenia fetida



Image: Eisenhauer, N., and E. Eisenhauer. 2020. The intestines of the soil: the taxonomic and functional diversity of earthworms." DOI: 10.32942.

Earthworm Biology

1. Epigeic (leaf litter 1-3")
 - Ex: Red Wigglers
2. Endogeic (topsoil 6-10")
 - Ex: Pale colored worms
Aporrectodea Spp.



Image: Eisenhauer, N., and E. Eisenhauer. 2020. The intestines of the soil: the taxonomic and functional diversity of earthworms." DOI: 10.32942.

Image: Joshua Puhlick, Non-Native Earthworms Invade Forest Soils in Northern Maine, USA <https://doi.org/10.3390/f12010080>

Earthworm Biology

1. Epigeic (leaf litter)
 - Ex: Red Wigglers
2. Endogeic (topsoil)
 - Ex: Leaf worms
3. Anecic (subsoil up to 6ft)
 - Ex: Common nightcrawler

Common nightcrawler
Lumbricus terrestris

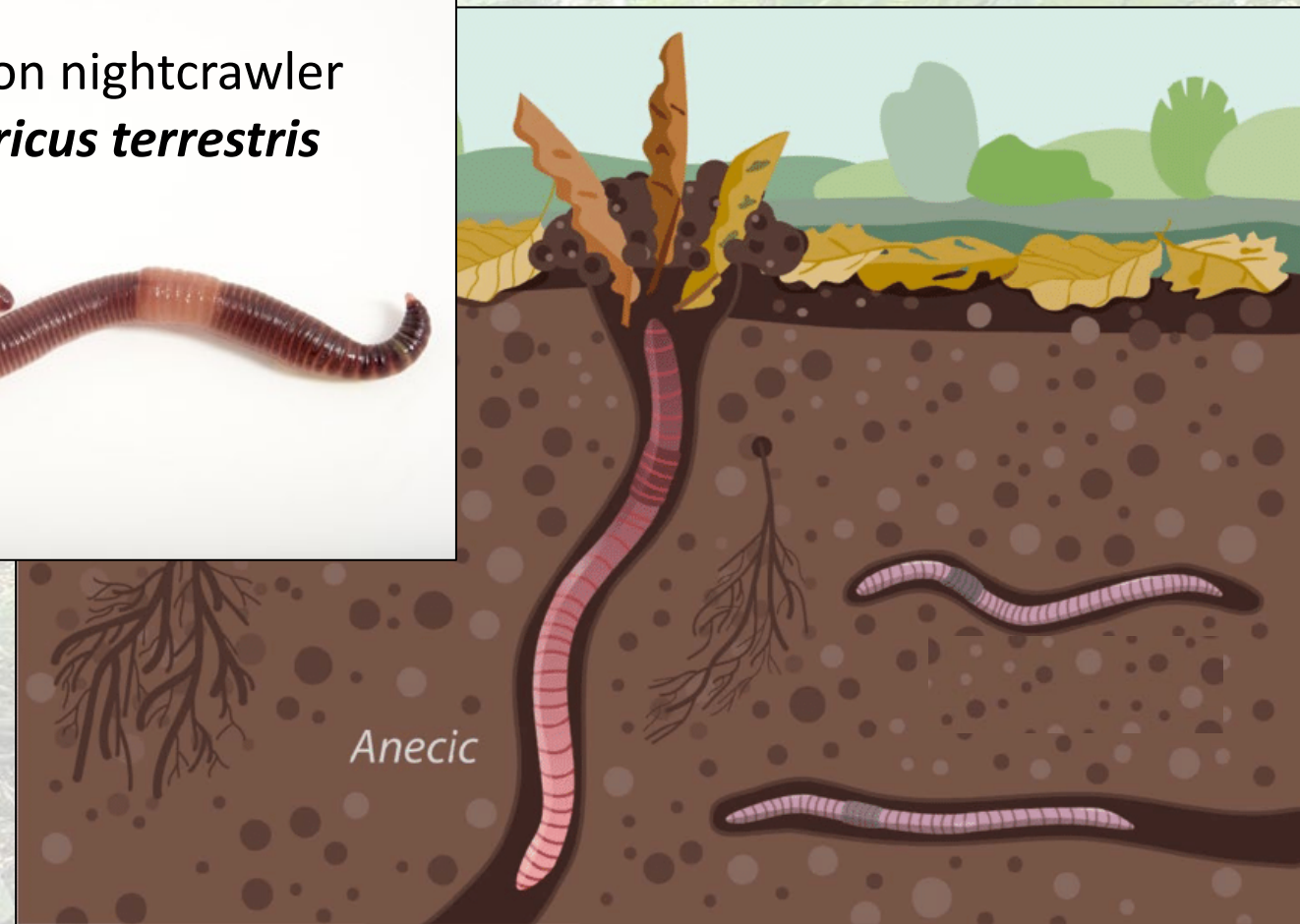


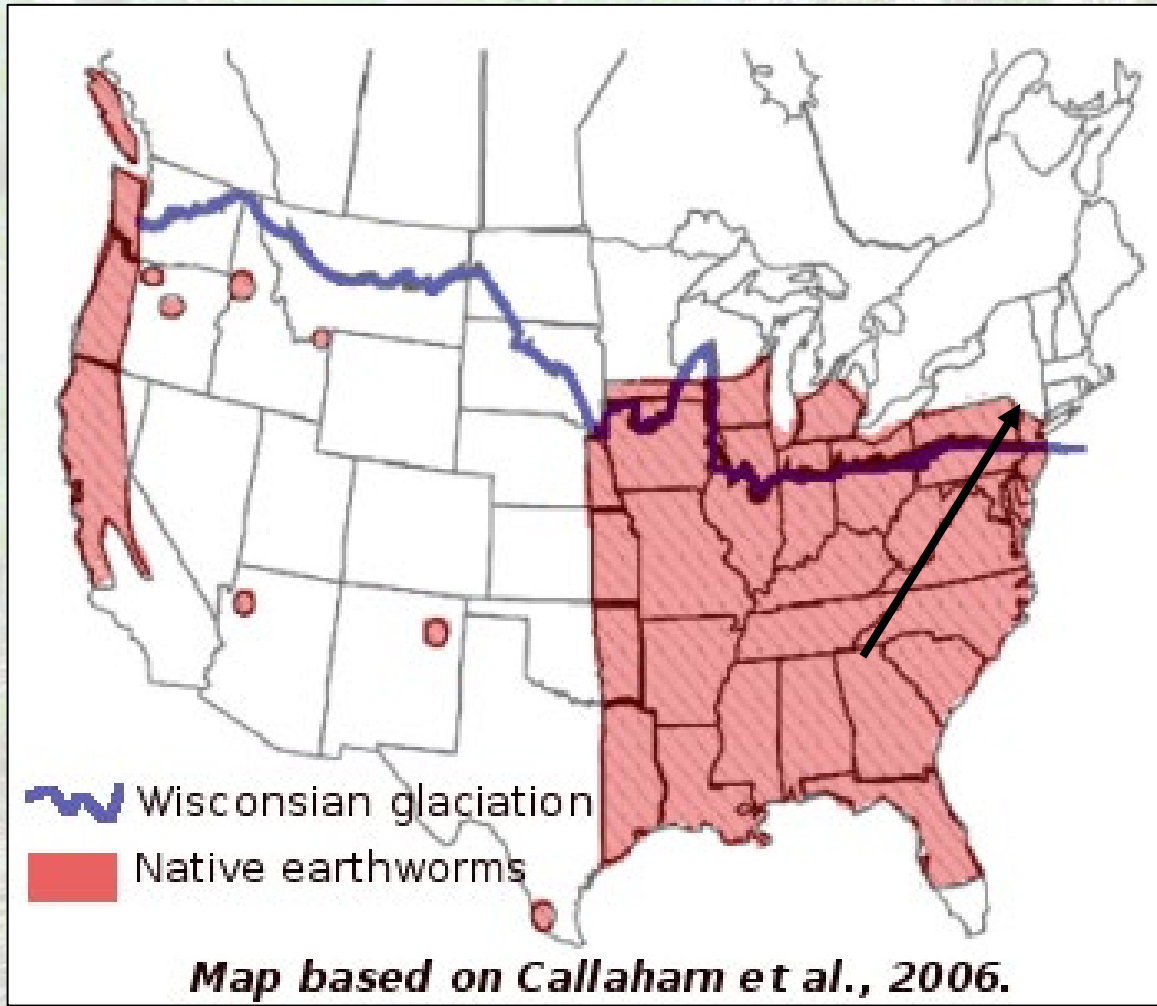
Image: Eisenhauer, N., and E. Eisenhauer. 2020. The intestines of the soil: the taxonomic and functional diversity of earthworms." DOI: 10.32942.

There are no native earthworms in Maine



- Few native earthworms in northern US
- Glaciation event killed northern worms ~10,000 years ago

There are no native earthworms in Maine



- Native earthworms have expanded northward but not into Maine
- Worms in Maine were introduced from Europe and Asia...

What are Jumping Worms?

- 3 species
 - *Amyntas agrestis*, *Amyntas tokioensis*, and *Metophire hilgendorfi*
- AKA: Crazy Worms, Snake Worms, “Alabama Jumpers”
- Native to eastern Asia
- Non-native & invasive in North America



Image: Jumping worm

Earthworm Biology



Jumping Worms

Found on the top 2 inches of soil layer

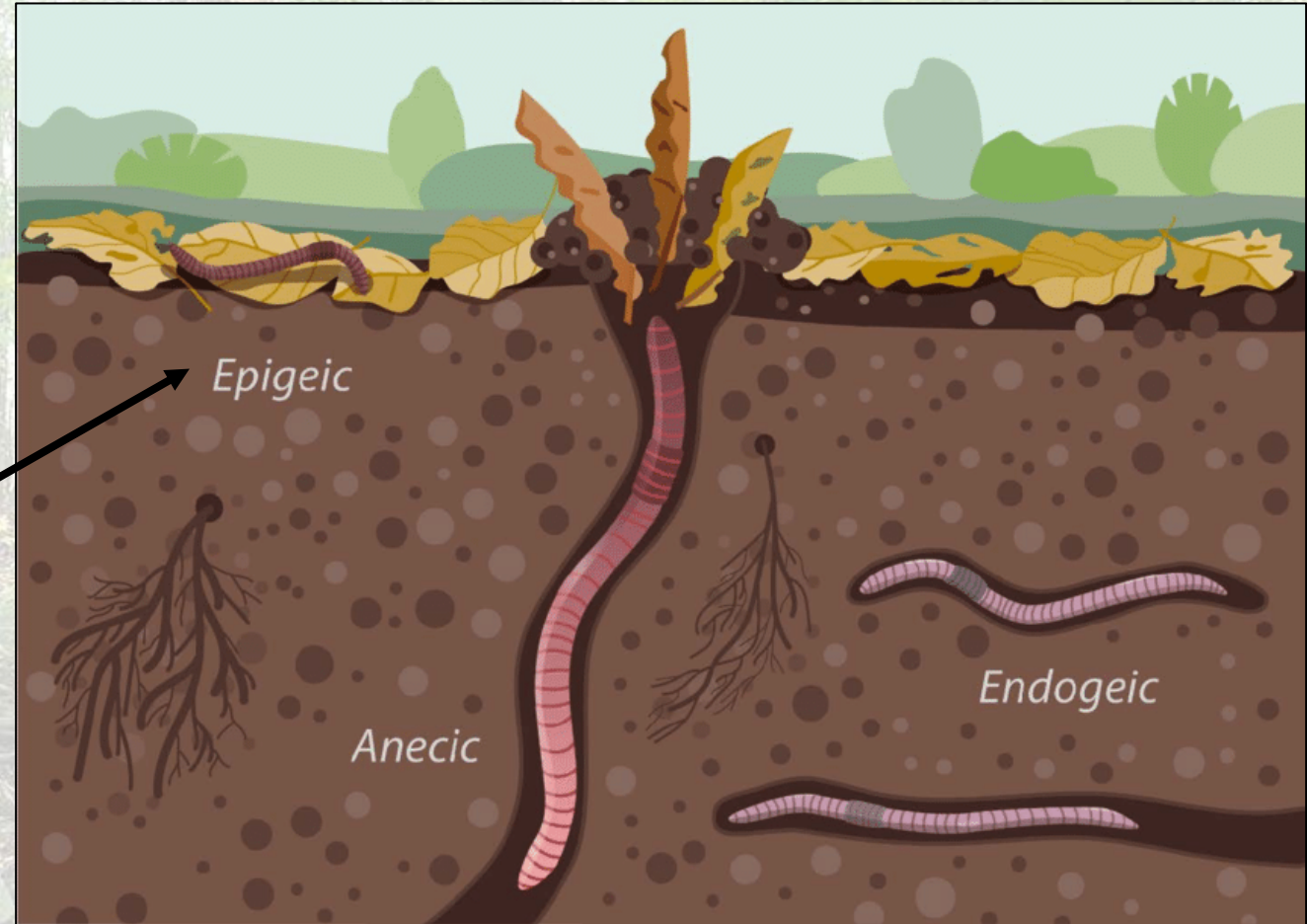


Image: Eisenhauer, N., and E. Eisenhauer. 2020. The intestines of the soil: the taxonomic and functional diversity of earthworms." DOI: 10.32942.

Jumping Worms Life Cycle

- Only live 1 year
- Grow fast, all energy into reproduction
- Parthenogenetic = can reproduce on their own

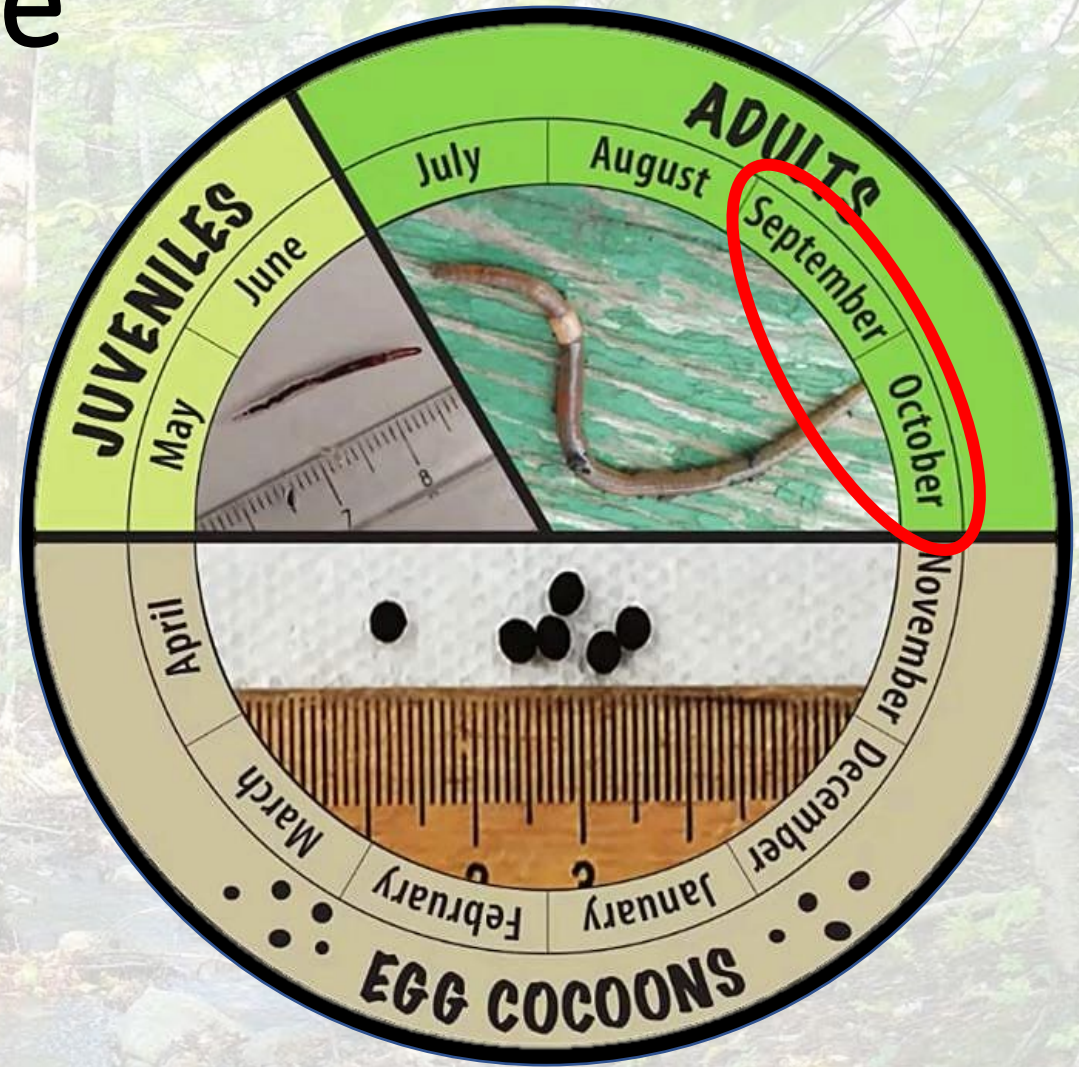


Image: K. Johnson, Wisconsin

Jumping Worms Life Cycle

- Overwinter as eggs inside small cocoons
- Silk cocoons protect them from cold and drought
- Cocoons are hard to detect and easy to spread

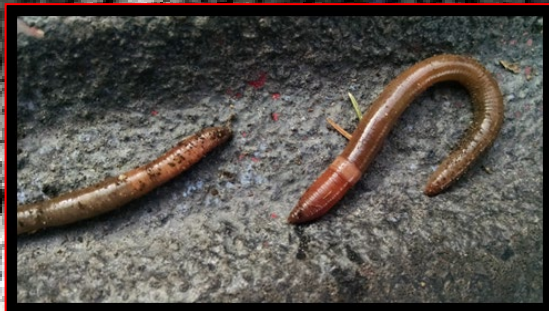


Photo: Wisconsin DNR

Biology & Ecology

WHY THEY COULD BE A PROBLEM

- Reach maturity in 60 days – thus allowing for 2 hatches a season
- Tolerate soil pH above 5.0
- Voracious appetites
- Highly adaptive to temperature changes
- Cocoons winter over
- Adaptive, non-particular to habitat types
- Produces a unique soil signature
- Outcompetes /pushes out, infects, poisons?
Non-native European species of earthworms





A single Jumping worm or cocoon stowed away in a potted plant can go home with a customer and start a new infestation.

Moving soil from one place to another, the horticultural trade can facilitate the passive spread of invasive earthworms.

How can I identify Jumping Worms?



Photo: Brittany Schappach, Maine Forest Service

Worm identification keys

- Common nightcrawler
 - ✓ 2 – 6 inches long
 - ✓ Saddle-shaped, raised clitellum in the middle of the body (segment 32 – 37)
 - ✓ Widely paired setae (“hairs”)
 - ✓ Slow moving, shy behavior

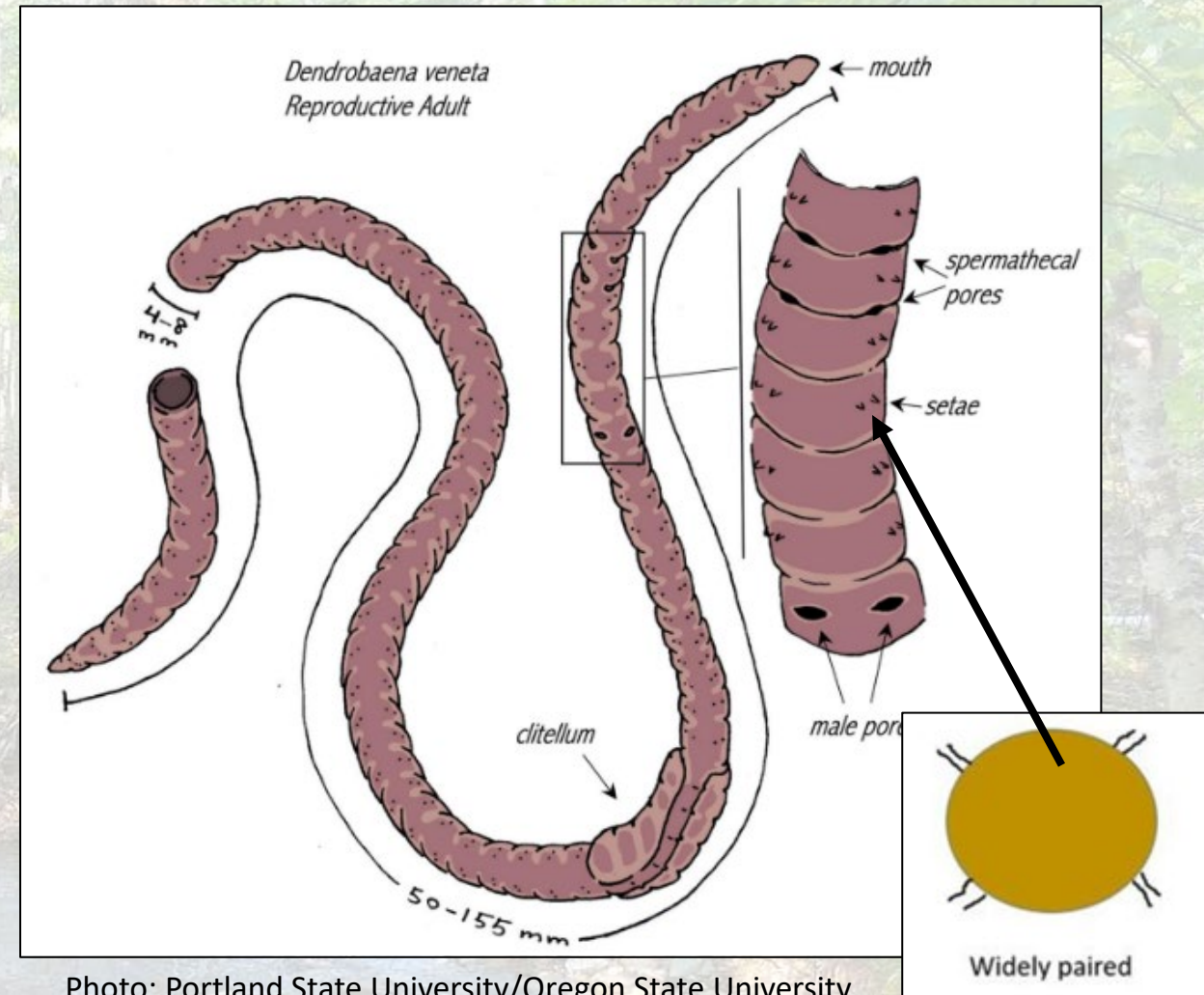


Photo: Portland State University/Oregon State University

Common nightcrawler

- ✓ Saddle-shaped, raised clitellum in the middle of the body (segment 32 – 37)
- ✓ Widely paired setae (“hairs”)

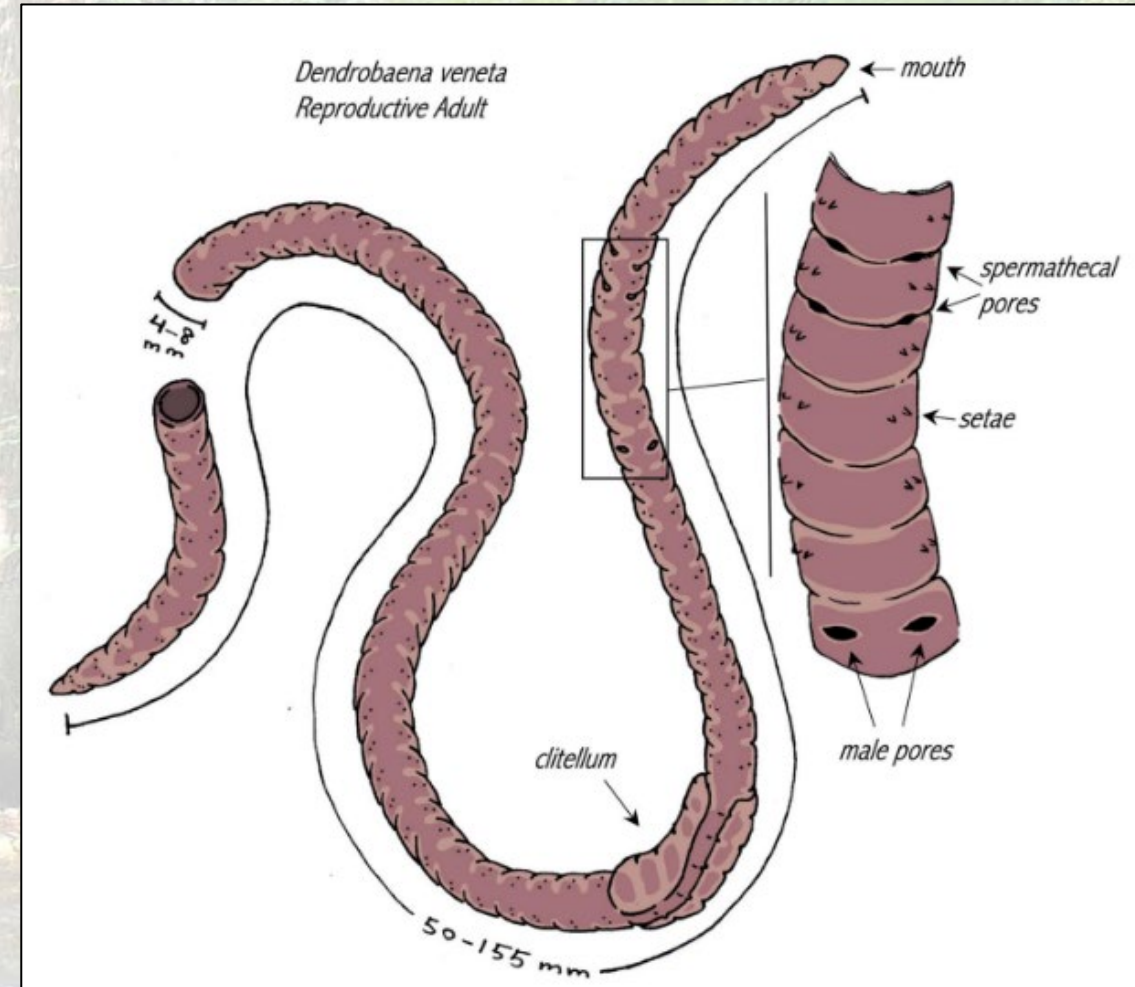
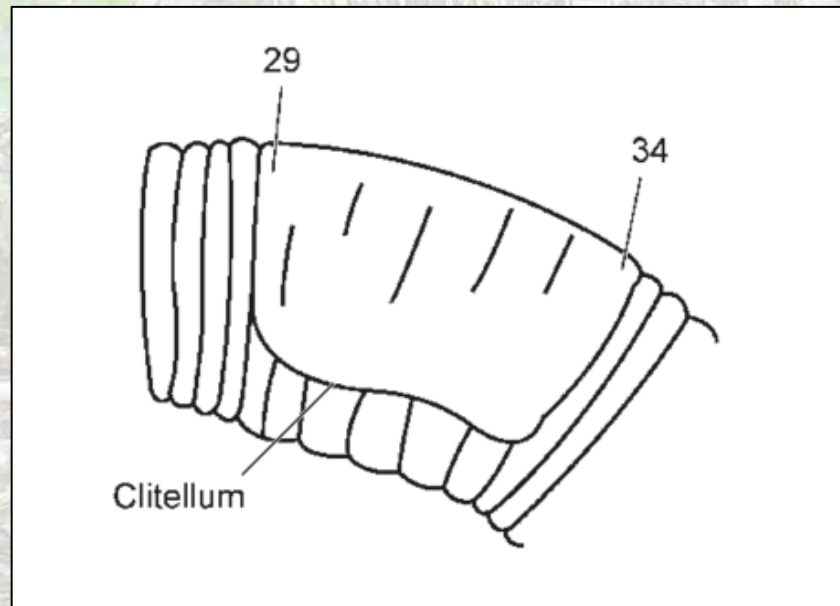


Photo: Portland State University/Oregon State University

Jumping Worms – Worm ID

1. Check the clitellum (Sept - Oct):

- ✓ Smooth and flat
- ✓ Milky white or gray
- ✓ Fully encircles worm
- ✓ Found on segments 14-16



Young worms are more difficult to identify



Photo: Brittany Schappach, Maine Forest Service

September



October



October

Jumping Worms – Worm ID

2. Check the setae (“hairs”)

- ✓ Each segment has many setae

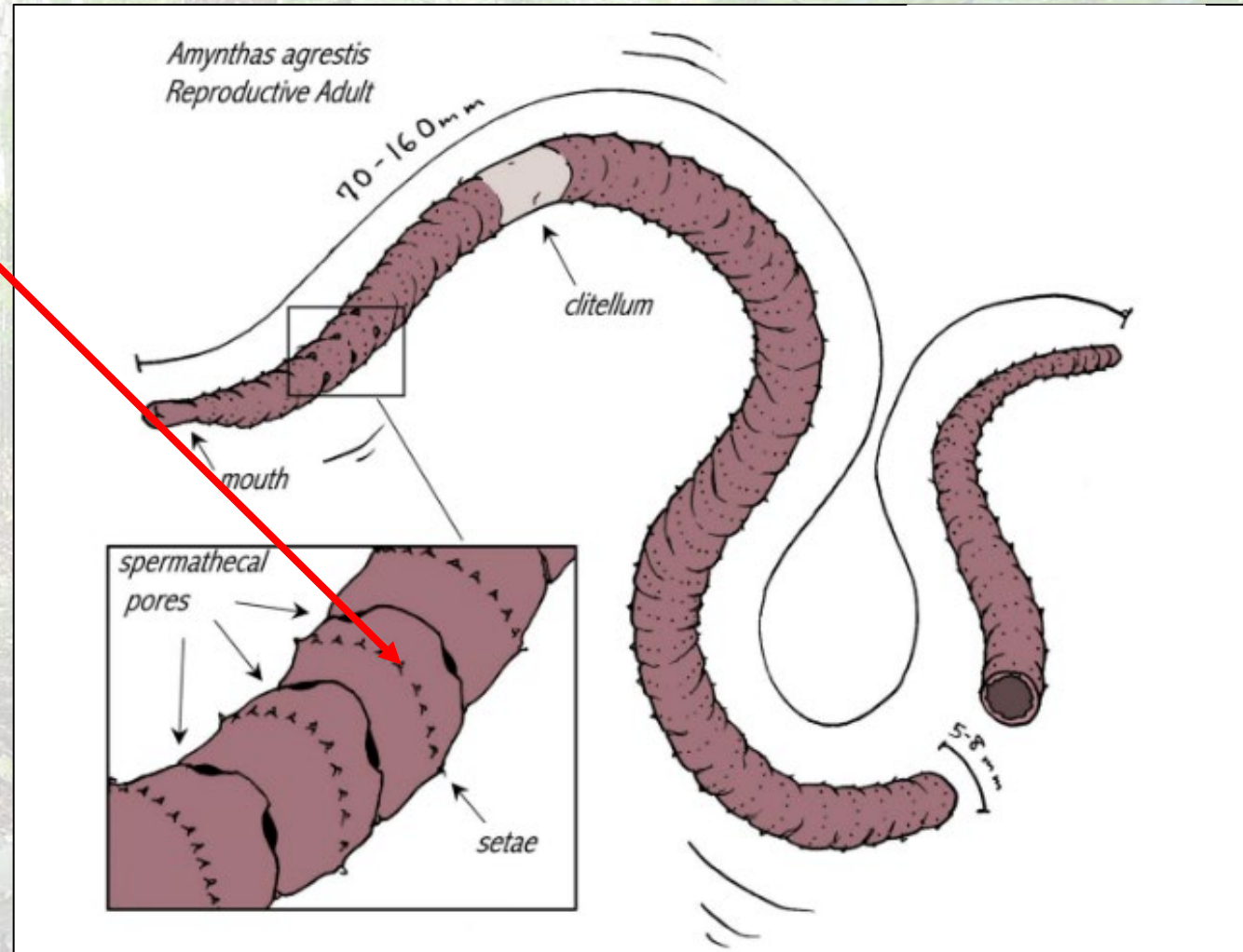
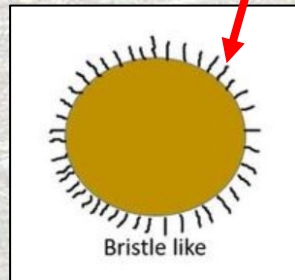
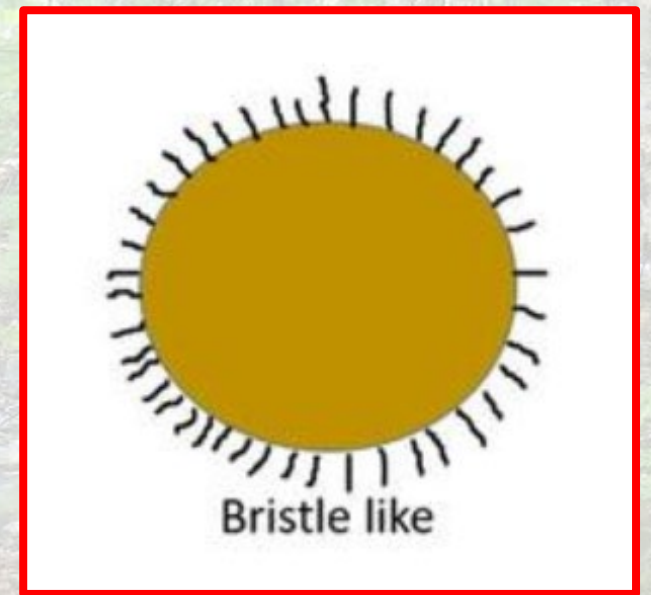
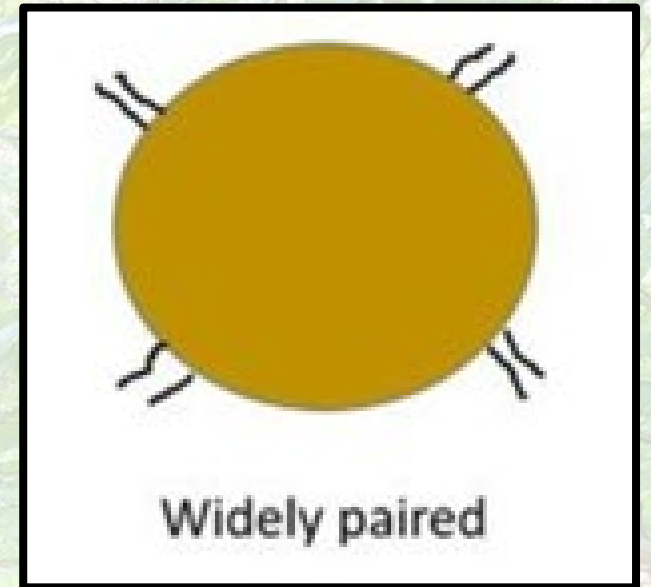


Photo: Portland State University/Oregon State University



©Oodles of organisms



Jumping worm

Jumping Worms – Worm ID

3. Check the behavior

- ✓ Thrashing, fast-moving, snake-like movements
- ✓ Serpentine locomotion
- ✓ Nose to tail

Despite the name, jumping worms can not “jump”

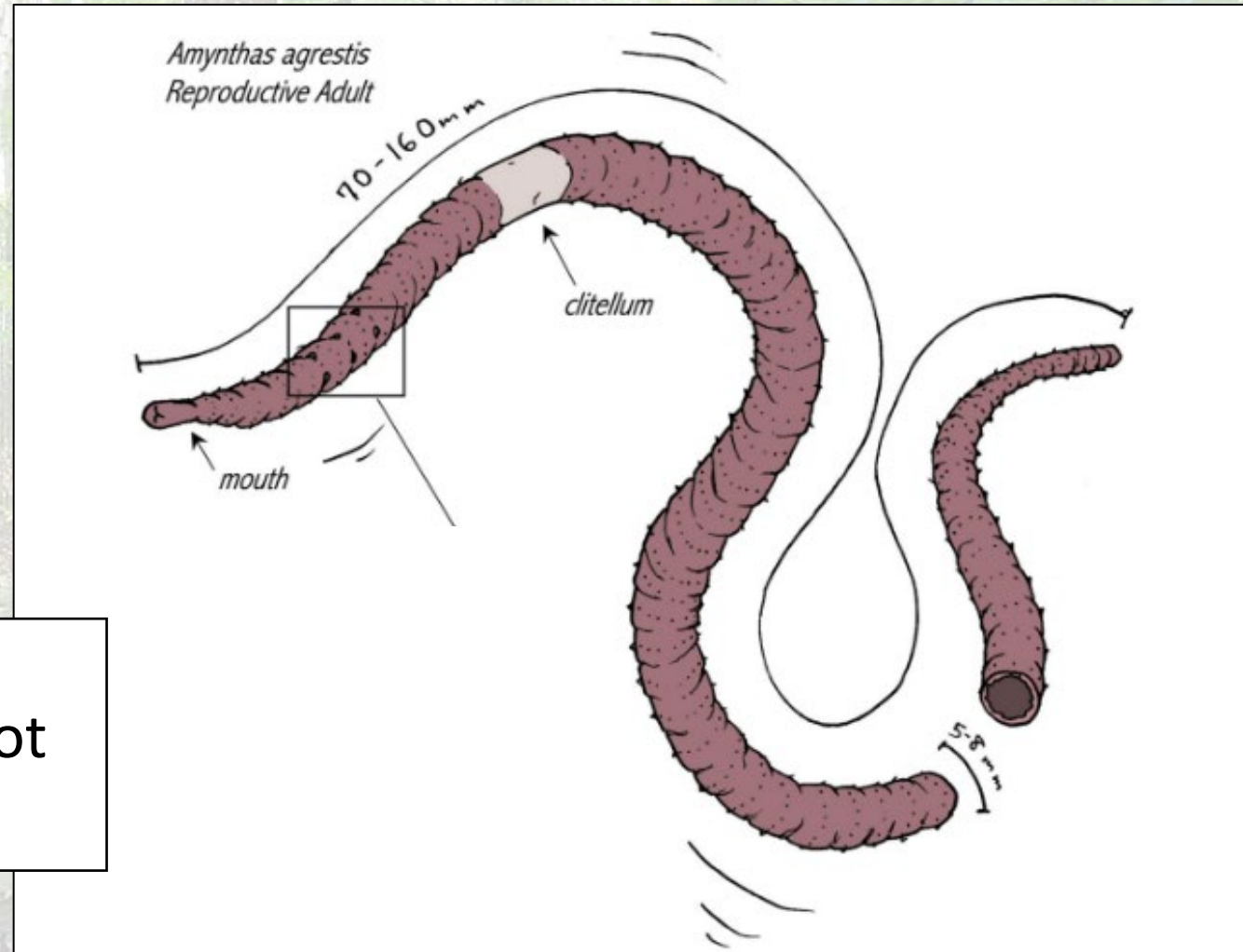


Photo: Portland State University/Oregon State University

Jumping Worms – Worm ID

4. Check for tail drop

- ✓ Other species of common earthworms in Maine often will not drop their tail when threatened

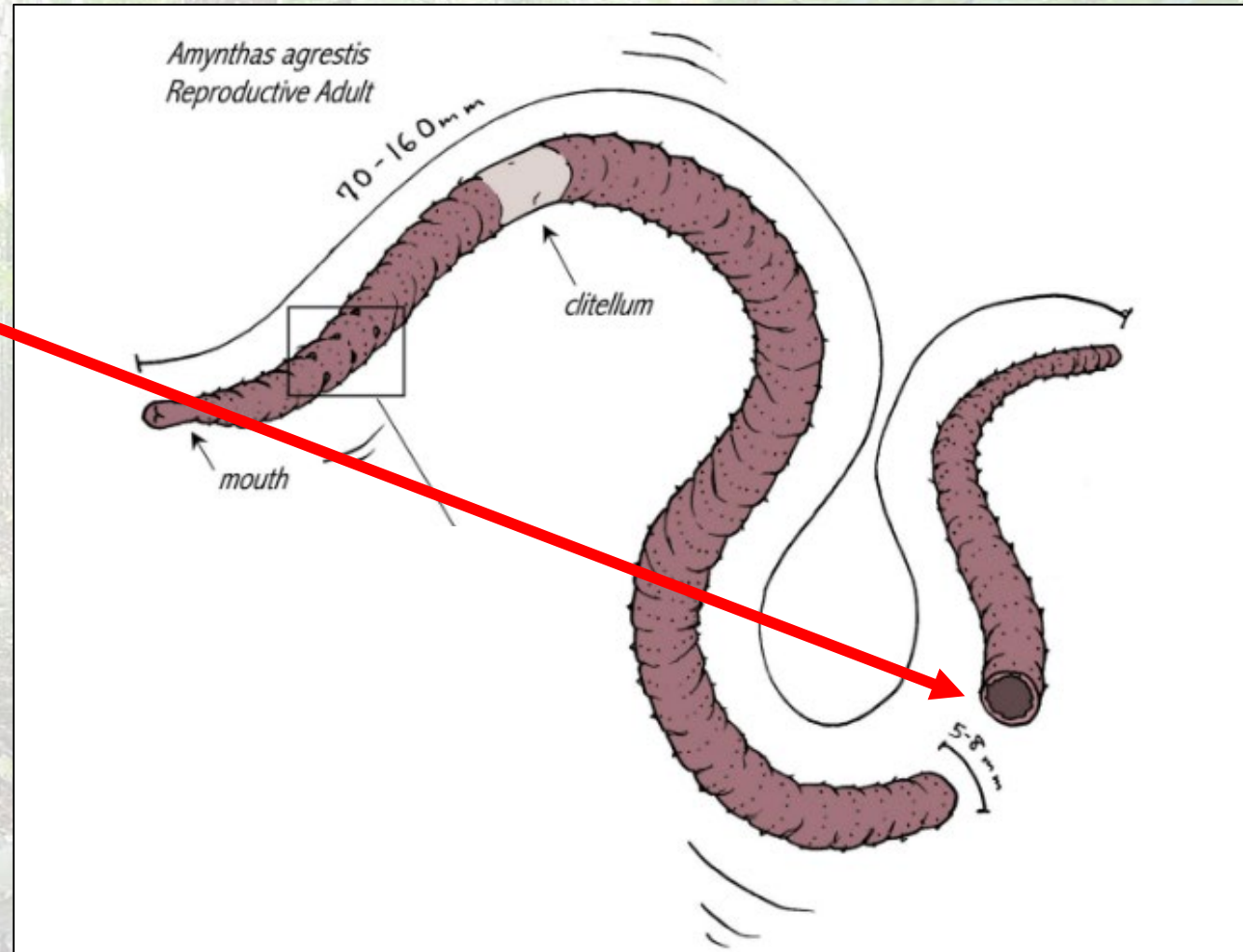


Photo: Portland State University/Oregon State University

Jumping Worms are currently expanding into areas around the globe, including North America, Central America, Europe, and Maine.

Dark gray = potential range of jumping worms

○ = Jumping worms confirmed

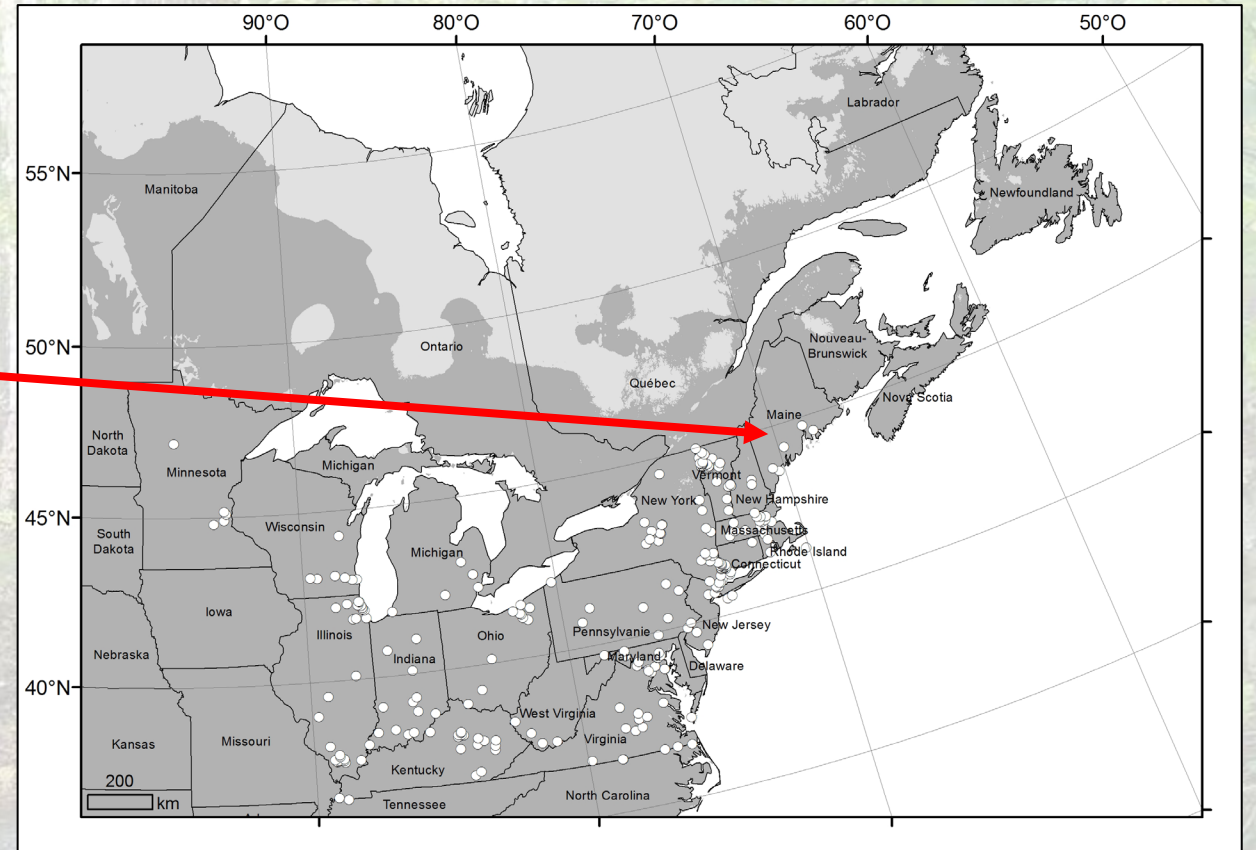


Image: Moore, J.D., J.H. Görres, and J.W. Reynolds. 2017. Exotic Asian pheretimoid earthworms (*Amyntas* spp., *Metaphire* spp.): Potential for colonization of south-eastern Canada and effects on forest ecosystems. *Environmental Reviews*, 999; 1–8.

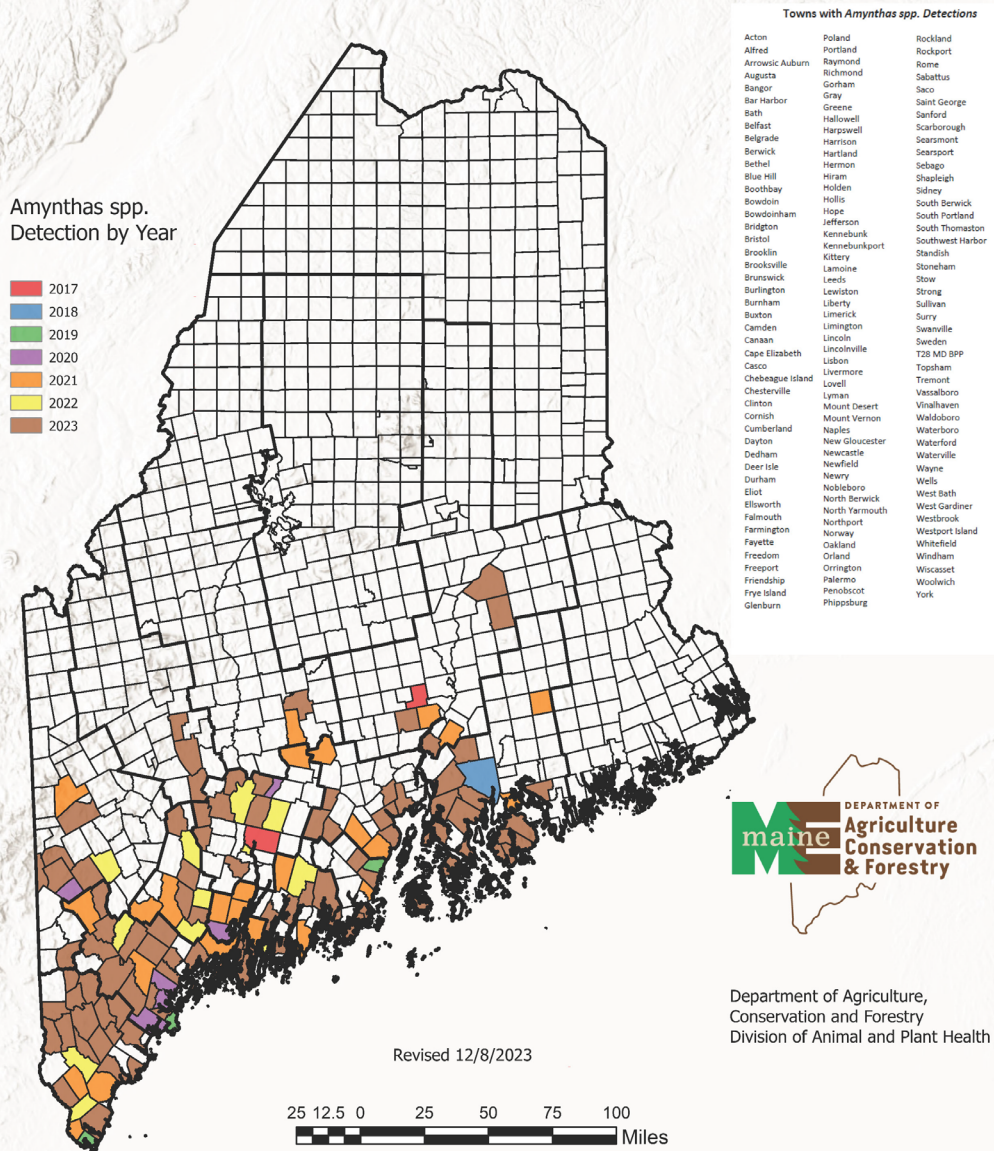
How did Jumping Worms get to Maine?



Photo: Susan Day, UW-Madison Arboretum

- Early records of the species are all associated with exotic plants
- The original introduction(s) came with soil or other organic material accompanying plants from Asia
- Can be spread in community mulch piles, potted plant sales, plant nurseries, composting, hiking boots, tires, fishing bait, wildlife, water flow...

Confirmed reports of *Amyntas* spp. in Maine by first reported year in town



Where are Jumping Worms in Maine?

- First found in a coastal Maine greenhouse in 1899
- Confirmed in 13 of the 16 counties
- Now considered widespread and seems to be expanding



Department of Agriculture, Conservation and Forestry
Division of Animal and Plant Health

Revised 12/8/2023



User: Jeff.Harriman O:\MFS\FHM\Harriman\Jumping Worm Confirmed Reports Esri, CGIAR, USGS

Survey – how are people learning about jumping worms?

How did you learn about jumping worms? *

Word cloud 



Sometimes the “bad” outweighs the “good”

U.S. >

Be on the lookout for “earthworms on steroids” that jump a foot in the air and shed their tails

BY LI COHEN

JULY 10, 2023 / 10:16 AM / CBS NEWS



Sometimes the “bad” outweighs the “good”

U.S. >

ARTICLES

Look Out for Jumping Earthworms!

An aggressive, introduced earthworm is negatively impacting our gardens and ecosystem. Find out how to recognize this invasive species and help limit its spread.

[Download](#) [Save for later](#) [Print](#) [Share](#) [f](#) [t](#) [in](#)

Updated: March 22, 2023

Sometimes the “bad” outweighs the
“good”

U.S. >

ARTICLES

Look Out for Jumping Earthworms!

Invasive Jumping Worms Have Been Found Across the Country—Here’s What You Need to Know

An aggressive

Download

22, 2023

Entomologists weigh in on the alarming creatures.



BY KORIN MILLER

PUBLISHED: MAY 24, 2022

Sometimes the “bad” outweighs the
“good”

U.S. >

Invasive Jumping worms can change their world

Sarah Farmer
Southern Research Station
April 22, 2022

You Need to Know

Entomologists weigh in on the alarming creatures.



BY KORIN MILLER PUBLISHED: MAY 24, 2022

Sometimes the “bad” outweighs the
“good”

NEWS

ENVIRONMENT

Invasive jumping worms damage U.S. soil and threaten forests

The writhing wrigglers devour leaf litter, changing soils and ecosystems as they go

Inv


Sarah
South
April

Jumping Worm Report Form – 2023 Surge in Reports!

- As of 11/22/2023, 388 total records since 2017
- Approx 400+ reports in 2023



Maine Jumping Worm Report Form



Location information

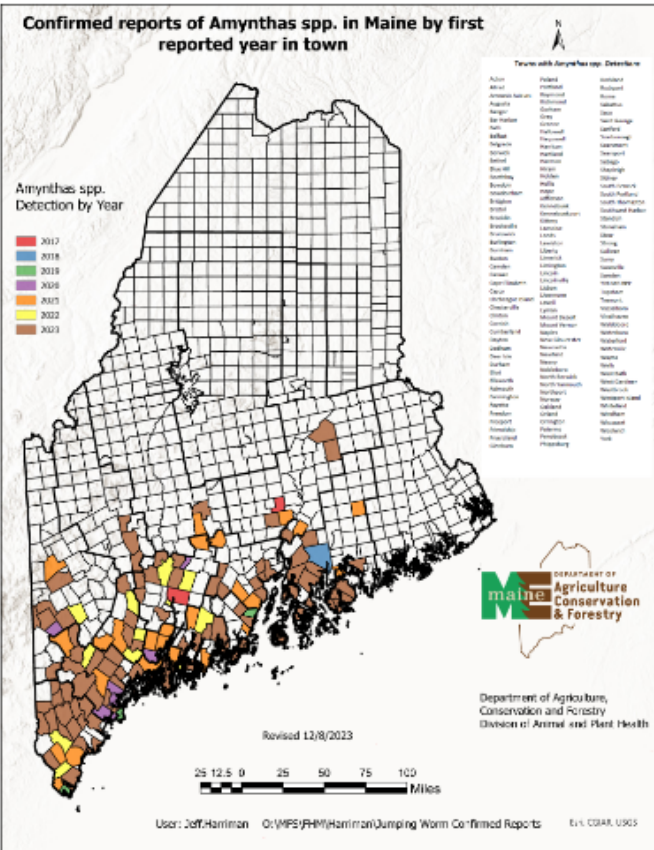
Before starting this form, we would like to emphasize that this worm is relatively widespread at this point (13 counties), so please do not panic if you have found it on your property. Here is the most recent distribution map of towns:

Confirmed reports of *Amyntas* spp. in Maine by first reported year in town

*Towns with *Amyntas* spp. Detection*

***Amyntas* spp. Detection by Year**

- 2017
- 2018
- 2019
- 2020
- 2021
- 2022
- 2023



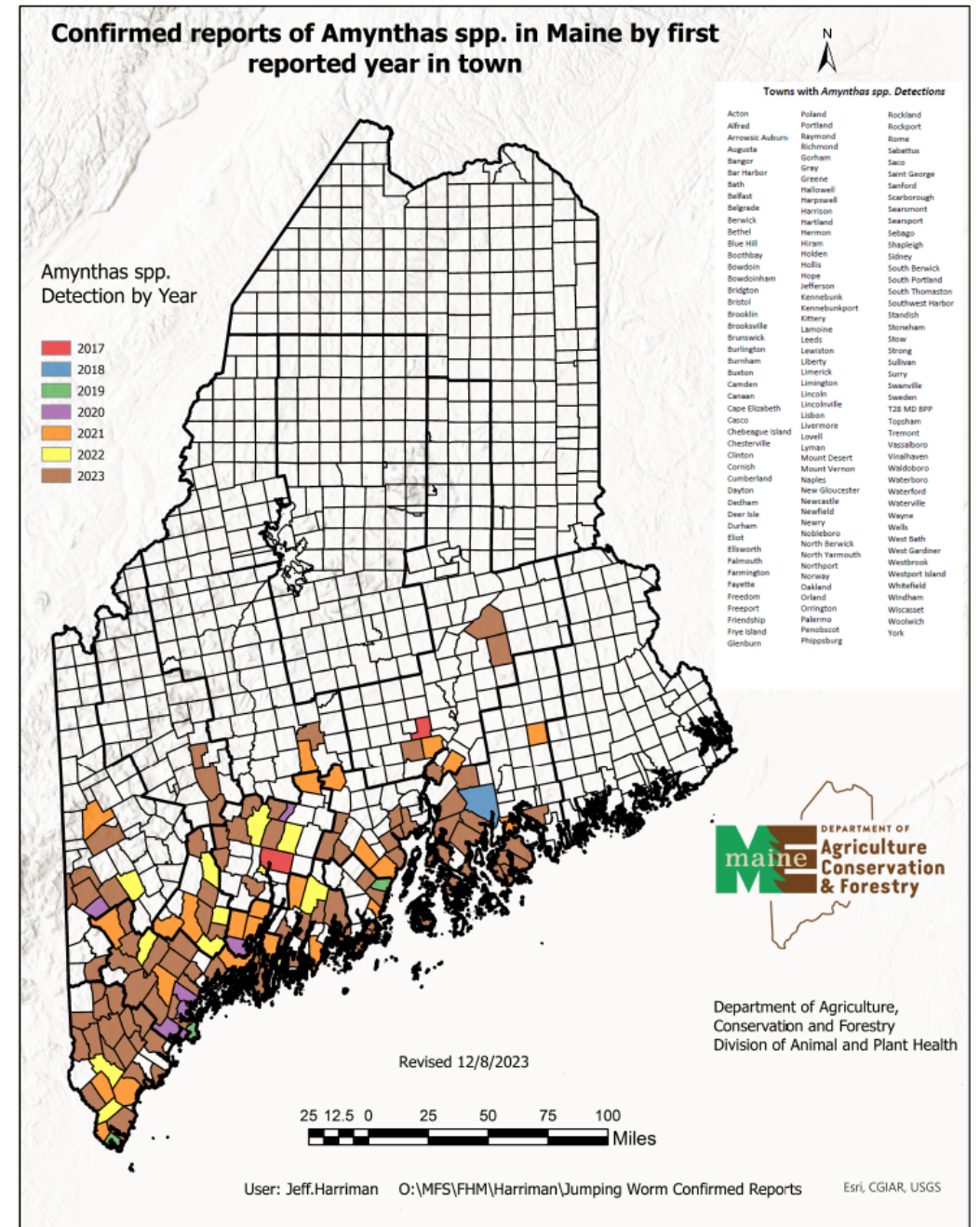
Revised 12/8/2023

25 12.5 0 25 50 75 100 Miles

User: Jeff-Harmon O:\MPS\JRH\Harmon\Jumping Worm Confirmed Reports E:\\ CGAR, USGS

Should you still report them?

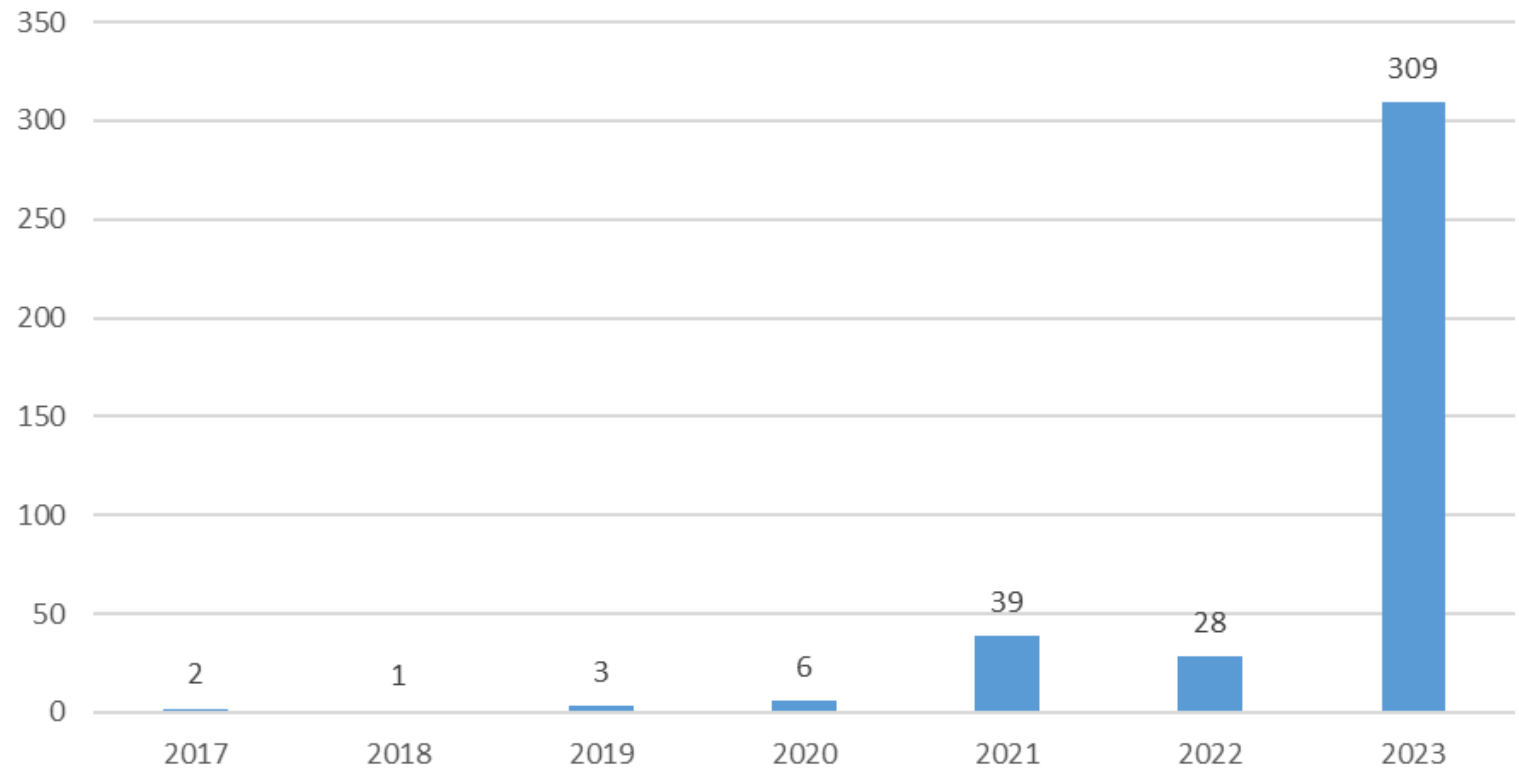
- Before starting this form, we would like to emphasize that this worm is relatively widespread at this point (13 counties) (I have received calls and reports from Aroostook and Piscataquis Counties as well), so please do not panic if you have found them on your property



2023 Surge in Reports

Count of Observation Date

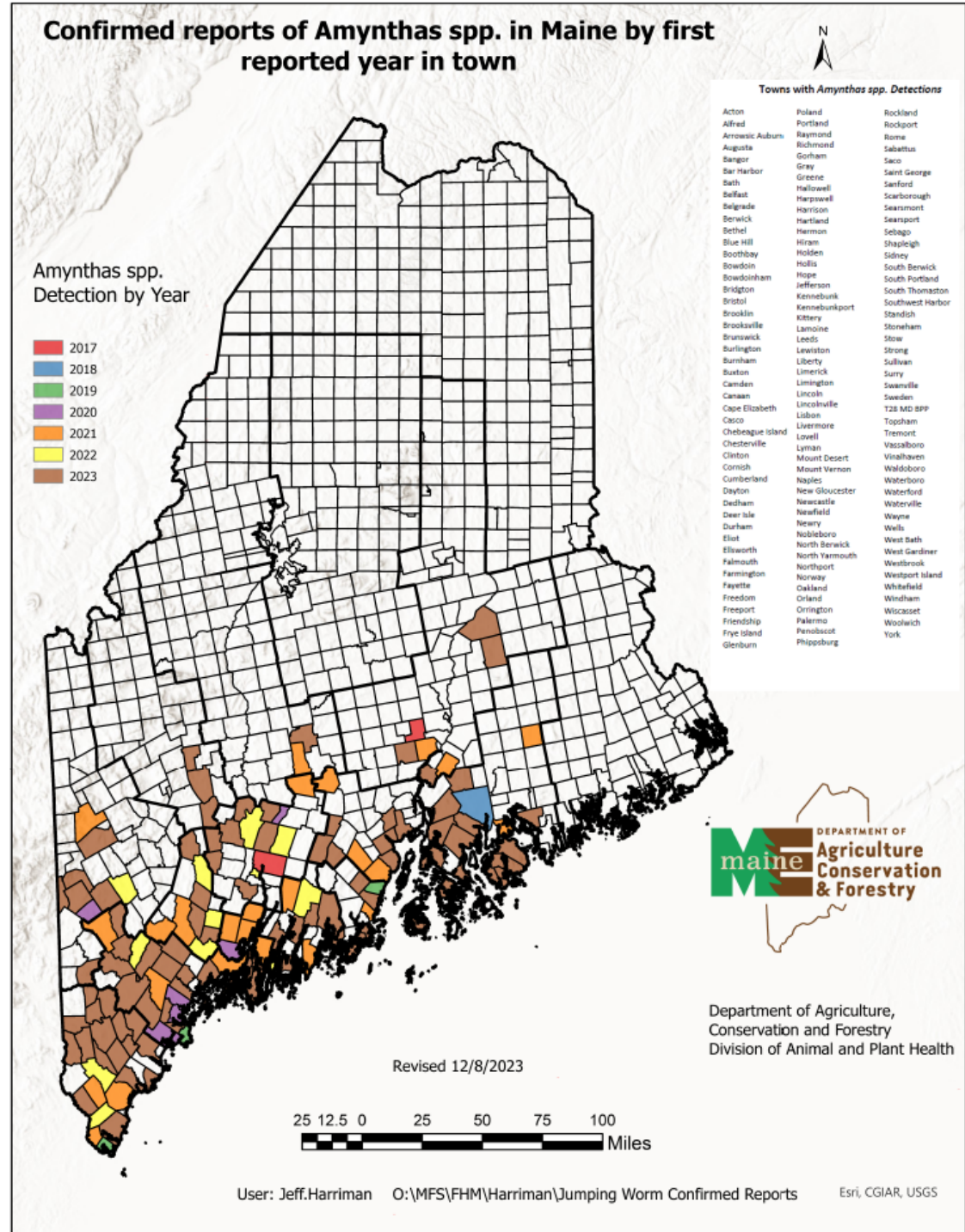
Positive Jumping Worm Observations by Year



Years
Observation Date

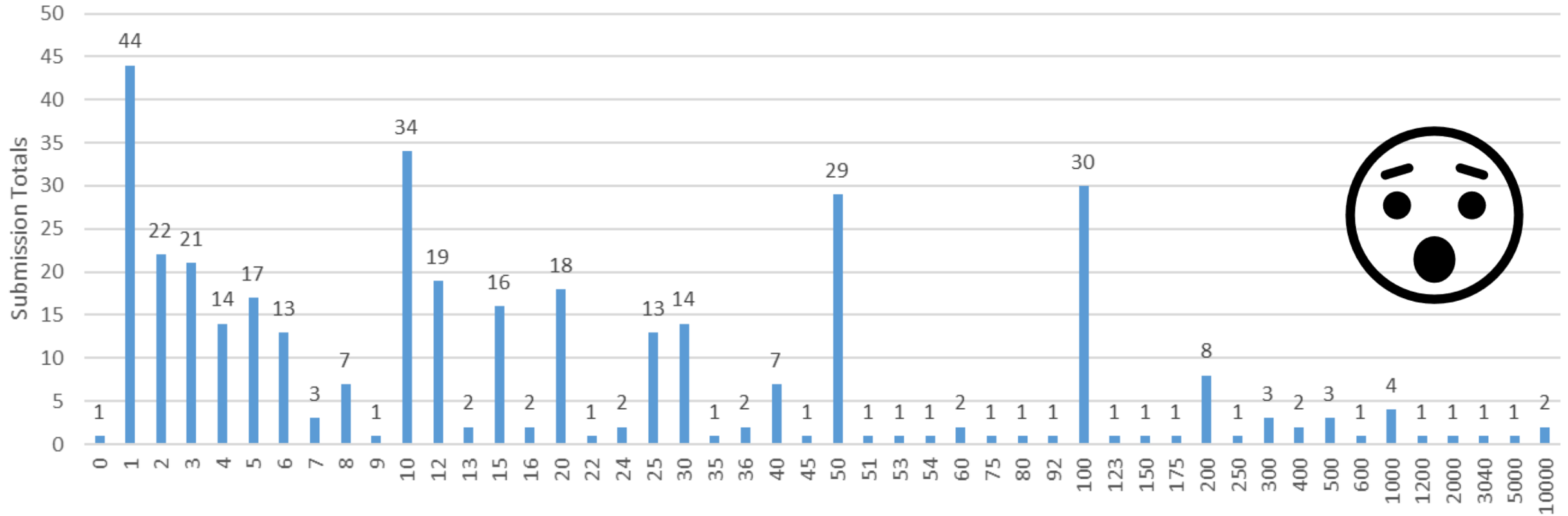
+ -

County	Total Confirmed Records
Cumberland	101
York	66
Hancock	45
Kennebec	33
Sagadahoc	27
Lincoln	26
Waldo	22
Androscoggin	21
Knox	19
Oxford	10
Penobscot	9
Franklin	4
Somerset	2



Count of How many worms did you see?

Estimated Number of Worms Seen in Observations



How many worms did you see?

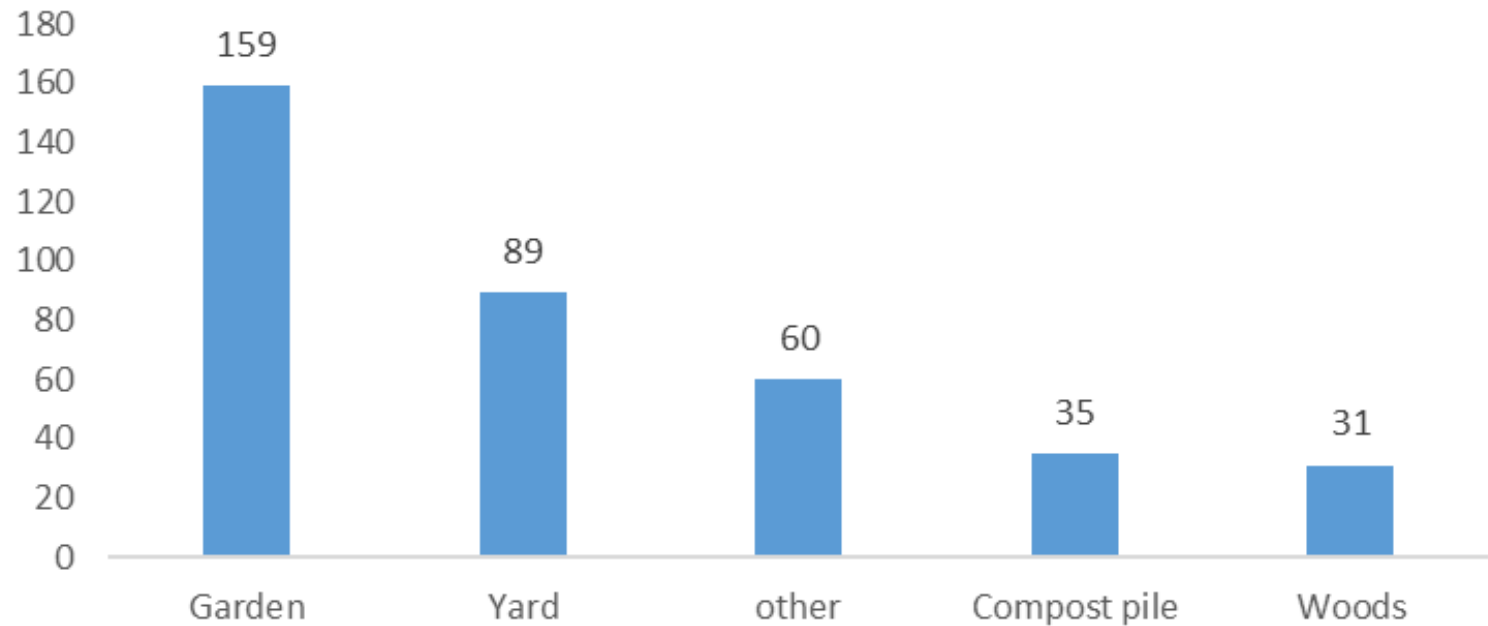




Jumping Worm Report Form Stats (confirmed only)

Count of Habitat worm(s) were found in:

Habitats Jumping Worms were Observed In
(2022 and 2023 Combined)



Habitat worm(s) were found in:

The real problem: Cocoons

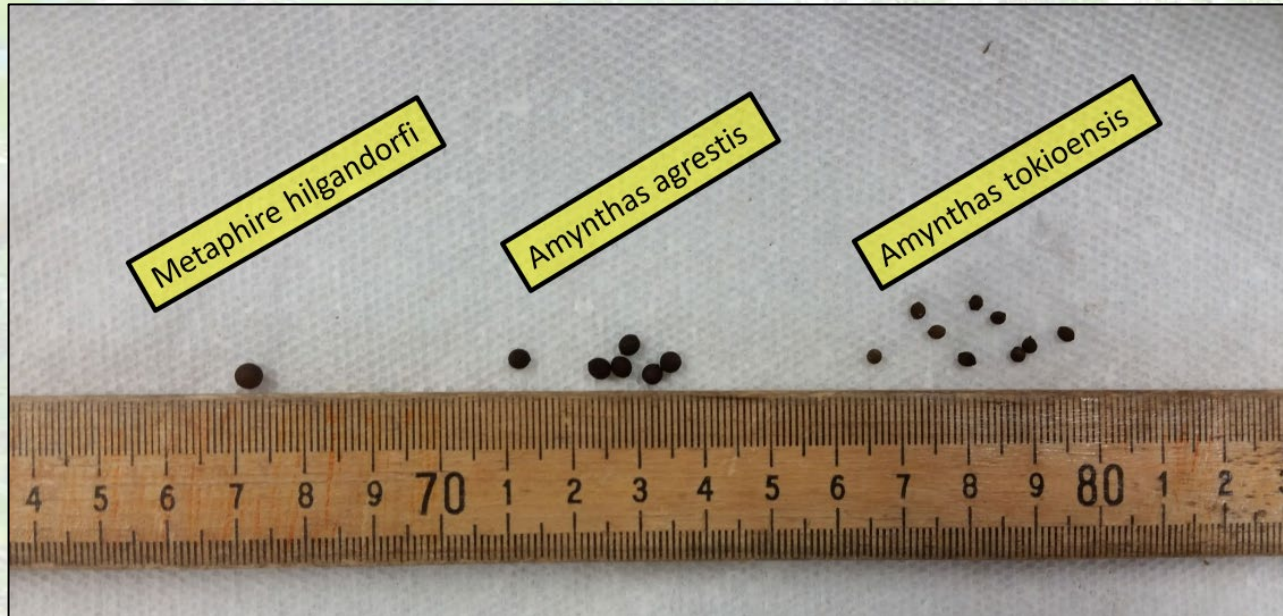
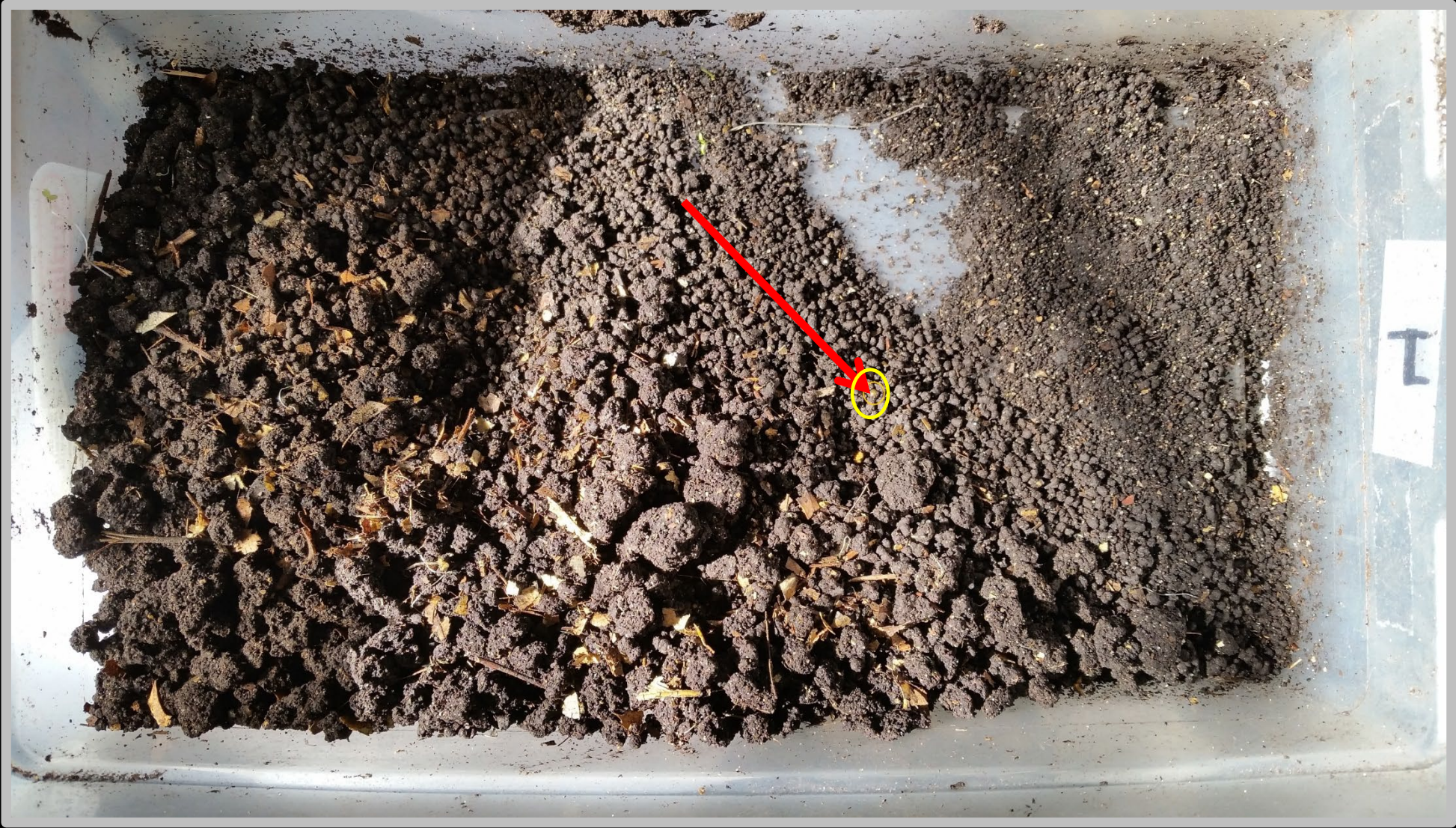


Photo: University of Wisconsin Arboretum

- Difficult to see and easy to spread
- Resistant to cold seasons in Maine
- “Seed banking”

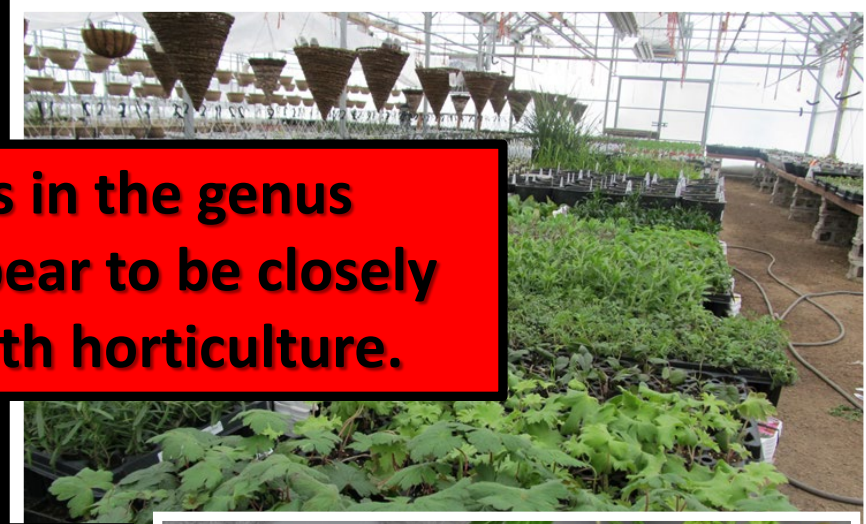




HOW ARE THEY SPREADING?



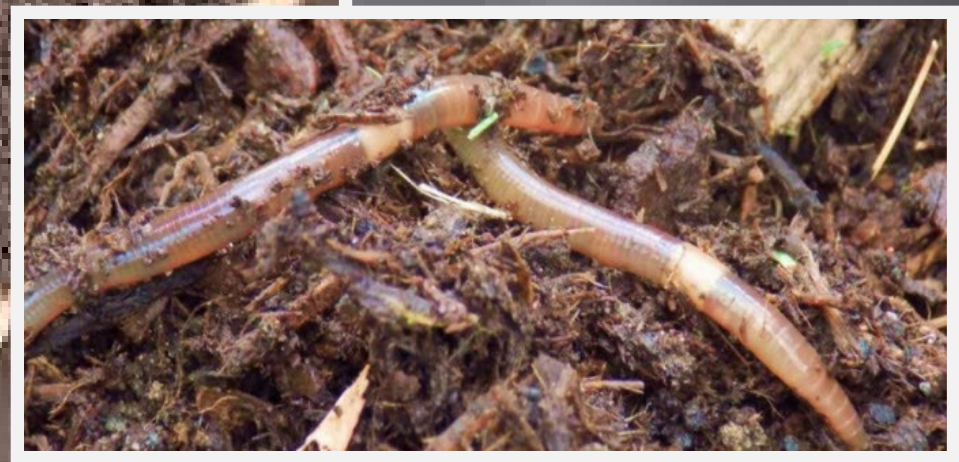
Earthworms in the genus *Amyntas* appear to be closely associated with horticulture.







Thanksgiving Dinner for Worms



HARDWOOD MULCH

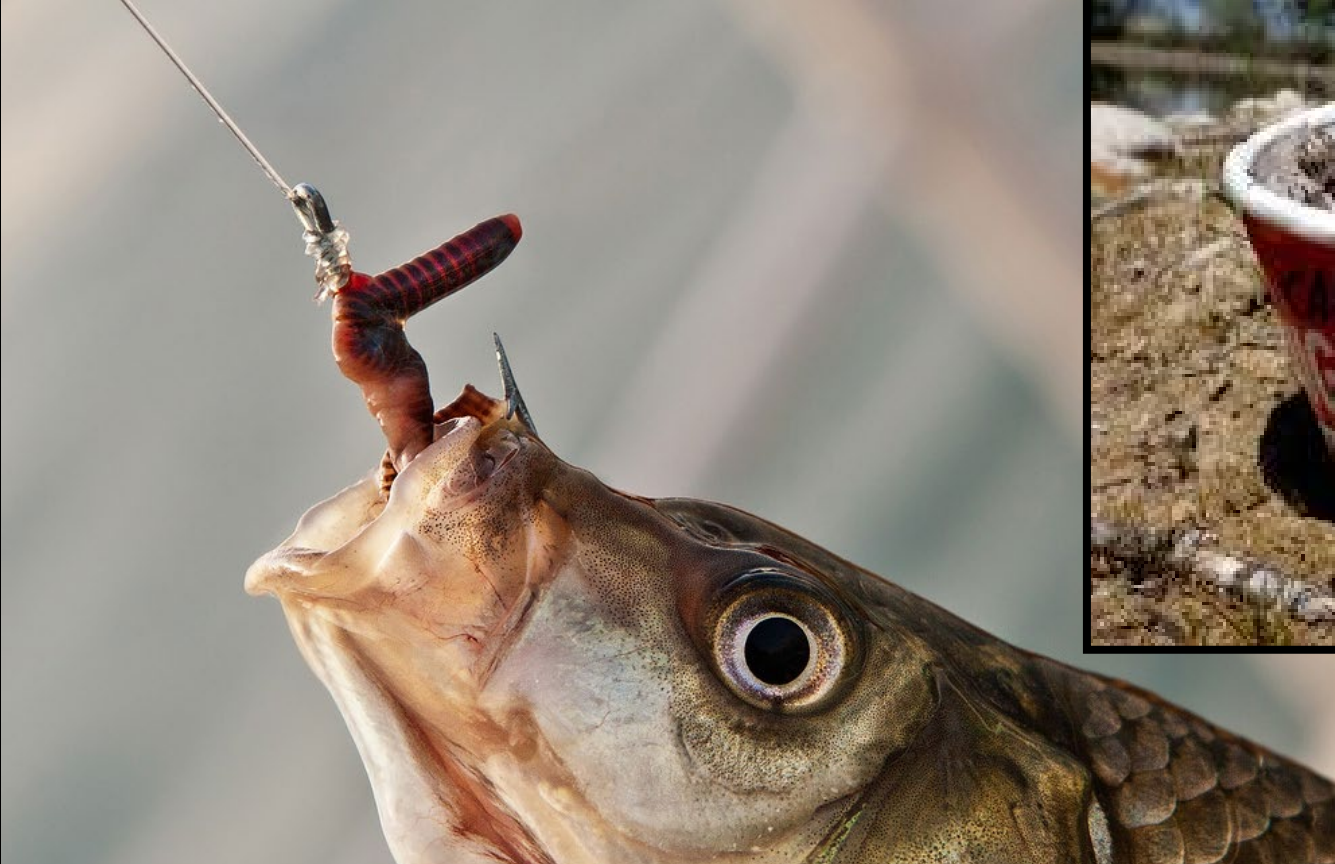






How
jumping
worms
spread





Dispose of Bait Worms in the Trash
Contain Your CRAWLERS!



What can Jumping Worms do to our forests?

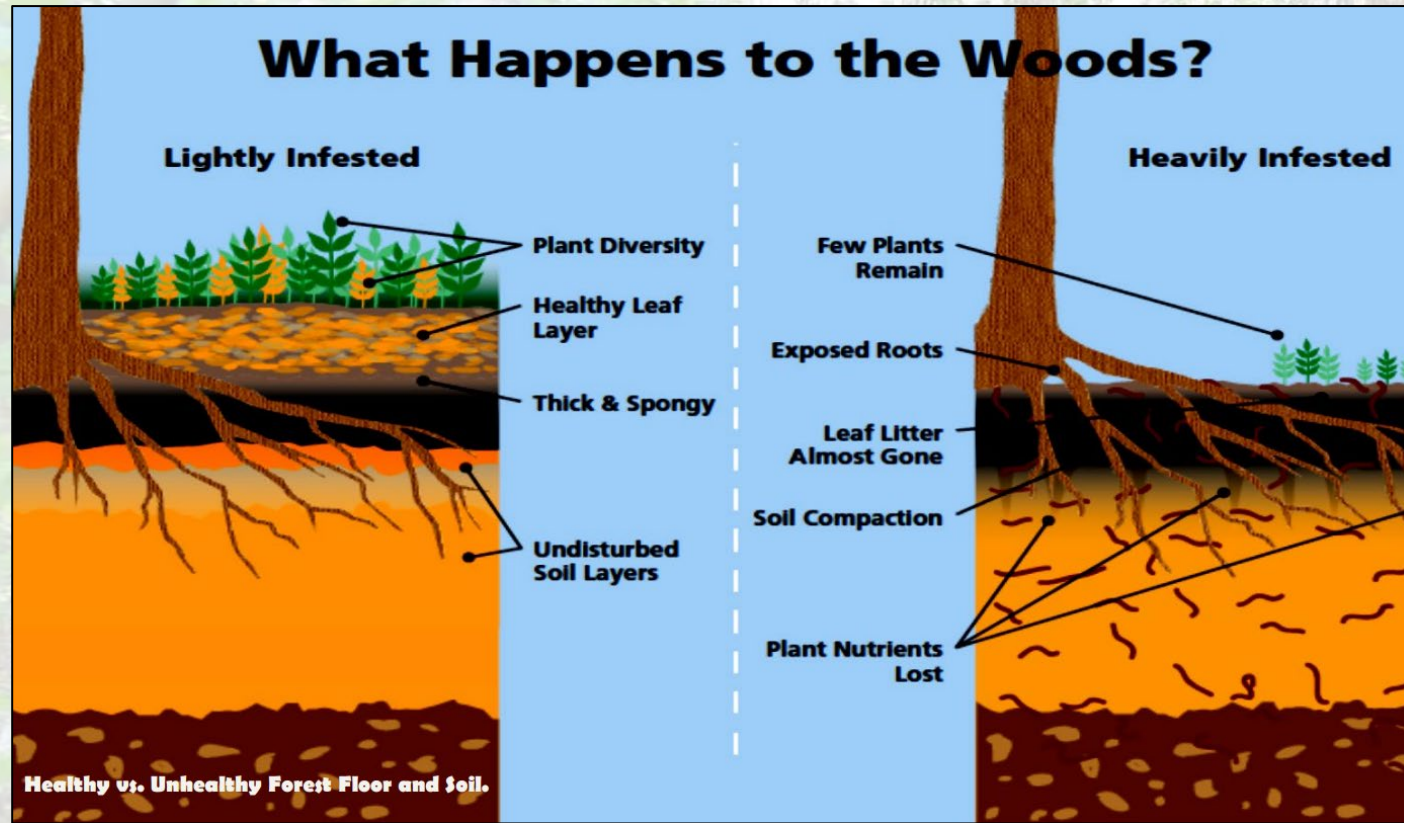
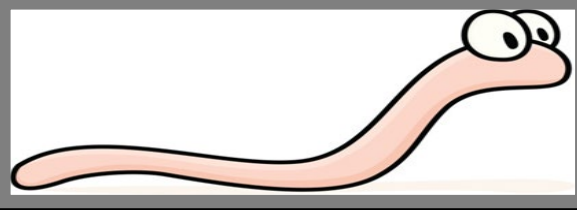


Photo: Wisconsin DNR



Plant diversity
Native plants & insects
Healthy tree roots
Leaf litter
Soil nutrients & moisture
Supported wildlife



Research at the UW-Arboretum

Biol Invasions
DOI 10.1007/s10530-016-1264-5



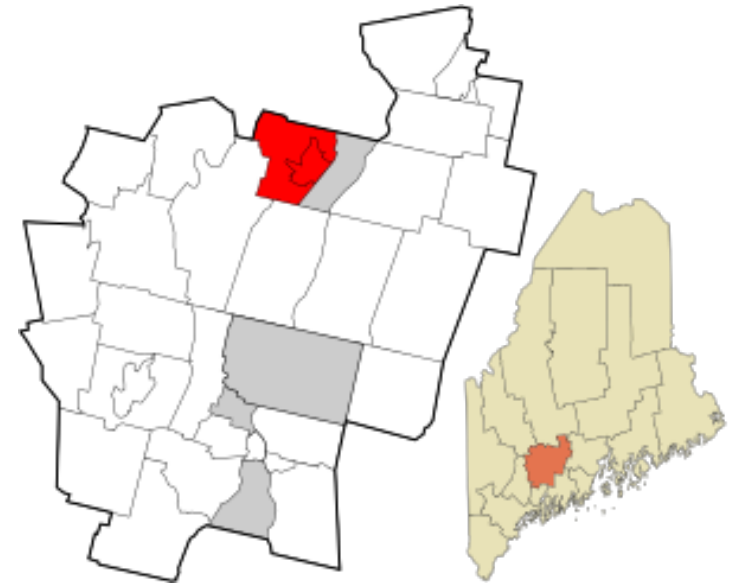
ORIGINAL PAPER

Effects of non-native Asian earthworm invasion on temperate forest and prairie soils in the Midwestern US

Jiangxiao Qiu  · Monica G. Turner

- *A. agrestis* and *A. tokioensis* substantially reduced leaf litter, and increased total carbon, total N, and avail. P from 0-2 inches.
- Increased inorganic N and TOC from 0-10 inches.
- Effects were observed in both forest and prairie soil, with stronger effects in forests.
- Depletion of litter layer and rapid mineralization of nutrients may make ecosystems more susceptible to nutrient losses.

Are they
getting into
our forests?



What can Jumping Worms do to our forests?

- Changes soil consistency



Photo: Brittany Schappach, Maine Forest Service

Why is loose soil bad?



Photo: Susan Day, UW Madison Arboretum

- Erosion
- Drier soils
- Less nutrient rich soil

Why is loose soil bad?



Photo: Brittany Schappach, Maine Forest Service

- Loose soil/castings wash away very easily = exposed plant and tree roots over time
- Soil can become compacted over time = limits movement of water, air, nutrients



Photo: Brittany Schappach, Maine Forest Service

Poor soil

- Jumping worms' castings have nutrient rich organic matter
- **BUT** the worm castings are on the top of the soil, inaccessible by most plants or trees
- Fungus-root relationships can be reduced



When a forest becomes heavily infested with earthworms:

- leaf litter is depleted
- soil is vulnerable to invasive species
- diversity of native plants and animals is reduced

They can be very damaging

Earthworm droppings are denser than the native soils resulting in more compacted soils

Earthworms impact the seed bank composition through excessive germination and reduced seedling survival

Research shows degraded root structures and fewer native seedlings in forests infested with earthworms, especially the epigeics



Correlation between forest damage & 'invasive' plant presence:

Observed in the field:

higher forest damage → 'invasive' plants presence more likely



Species observed:



- Common buckthorn (*Rhamnus cathartica*)
- Garlic mustard (*Alliaria petiolata*)
- Japanese barberry (*Berberis thunbergii*)
- Japanese honeysuckle (*Lonicera japonica*)
- Multiflora rose (*Rosa multiflora*)
- Oriental bittersweet (*Celastrus orbiculatus*)
- Winged Burning Bush (*Euonymus alatus*)



What can Jumping Worms do to our forests?



Forest damage =



Invasive plant presence



Garlic mustard
Alliaria petiolata



Japanese barberry
Berberis thunbergii



Glossy buckthorn
Rhamnus cathartica

Understory ground cover
plants that could be lost due
to crazy worm infestations

Trout lily

Trilliums

Solomon's seal



Photos courtesy of Missouri Botanical Gardens



Ovenbird

Ground nesting forest birds and amphibians may also be disrupted by crazy worm infestations



Spotted Salamander



Hermit Thrush

© Larry Meade

Prevention

Arrive clean, leave clean:

- Clean soil and debris from vehicles, equipment, boots, and other gear before arriving/leaving hiking trails or forests



GIVE INVASIVE SPECIES THE BRUSH OFF

Clean your gear before entering and before leaving the recreation site.



STOP INVASIVE SPECIES IN YOUR TRACKS.
PlayCleanGo.org

Prevention

- Clean gardening tools before moving to and from sites
- Ask landscapers or logging workers to clean their equipment before use
- Rinse roots to remove soil clumps, place soil clumps into trash bag in the sun before disposing





Prevention

- **Don't** purchase jumping worms for composting, vermicomposting, gardening, or fishing bait
- **Don't** discard live worms in the wild
- **Don't** discard infested yard waste in the woods
- **Do** teach others about jumping worms

Photo: Brittany Schappach, Maine Forest Service

Prevention



Photo: Brittany Schappach, Maine Forest Service
Life Cycle: K. Johnson, Wisconsin

Know the signs

- Educate yourself and others on recognizing jumping worms, their life cycle, and the soil characteristics
- Monitor for jumping worms (raking leaf layer, mustard solutions)

Prevention

Be a worm-wise buyer

- Check soil, compost and mulch for signs of jumping worms or cocoons
- Ask plant nurseries if they heat treat their soil/compost/mulch
- Choose bare-root plants over potted plants when possible



Monitoring with Mustard

How can I know if they are in my garden or forest?

- Ground mustard dissolved in water
- Prioritized counties that do not have jumping worms
- Boat launches, hiking trails, fishing spots

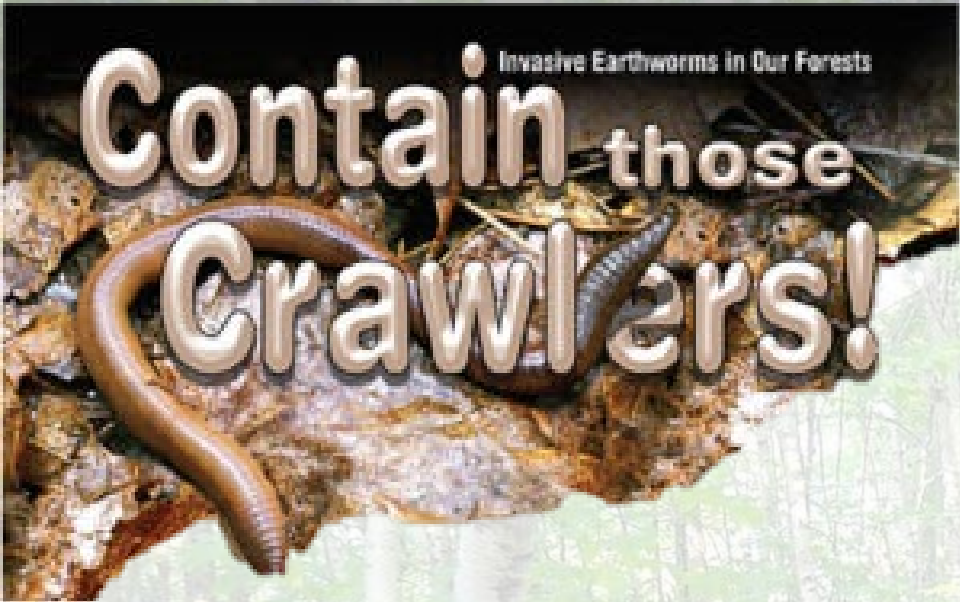


Photo: Brittany Schappach, Maine Forest Service

Mustard solutions are unlikely to harm most plants. This is only for detection and will not control the worms.

I think I have jumping worms

- If you suspect you obtained worms from compost or potted plants:
 - Reach out to the location you think you may have obtained the worms from and inform them
 - Reach out to me
 - gary.fish@maine.gov or 207-287-7545



I think I have jumping worms

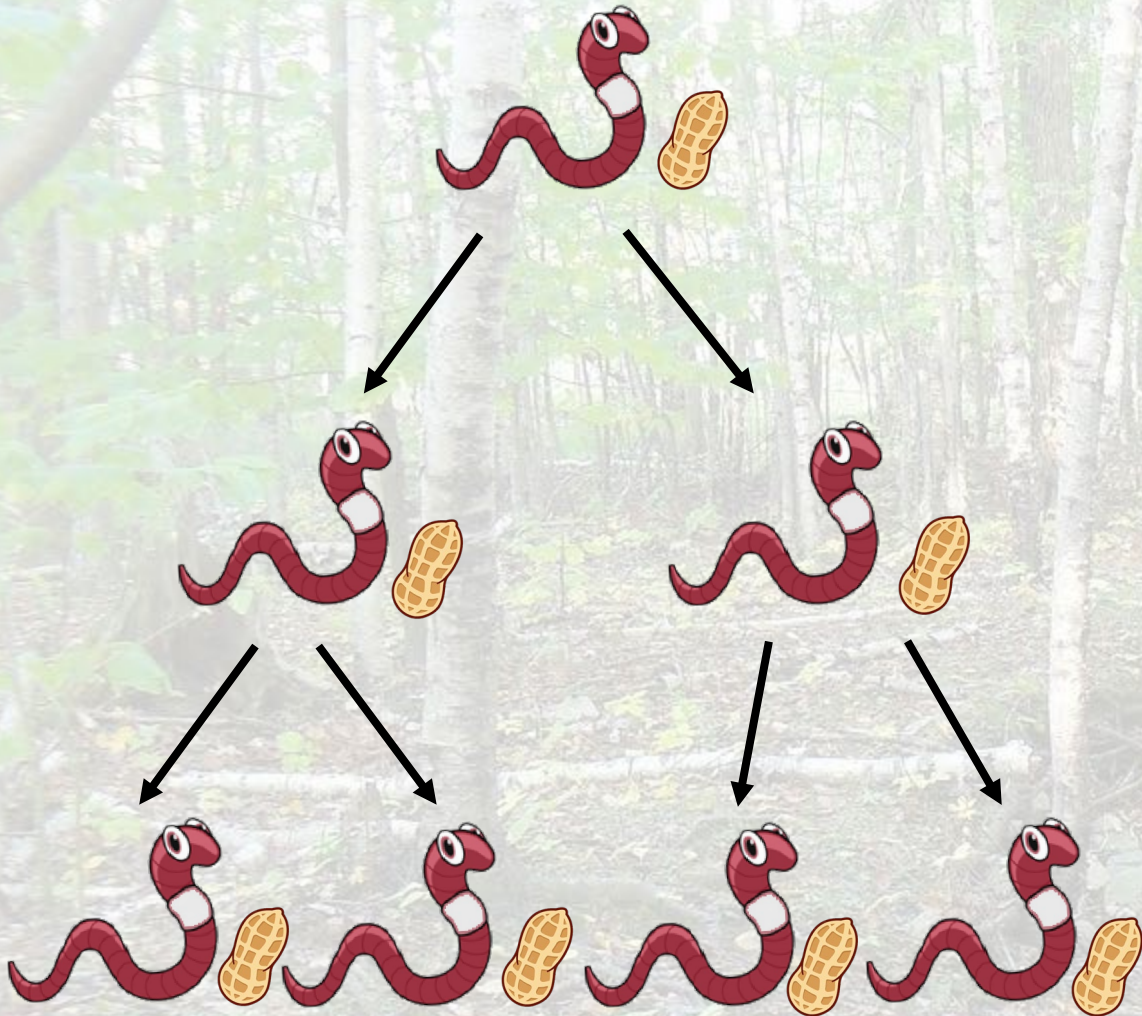
- Call us or send a report so we can help identify the worms.
- **Don't panic.**
- Focus on preventing their spread!

Management

- **IS TRICKY...** there's a lot that we don't know and are still learning. Research is ongoing!

Management

- **IS TRICKY...** there's a lot that we don't know and are still learning. Research is ongoing!
- Parthenogenetic = low genetic diversity = a management solution may be very effective for majority populations



CAN WE KILL THEM?

Research is being done...

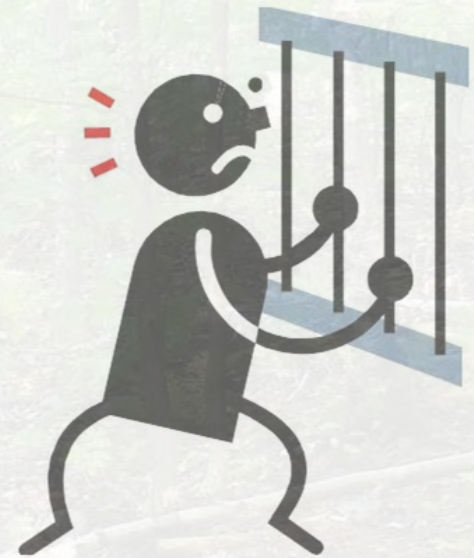


Management

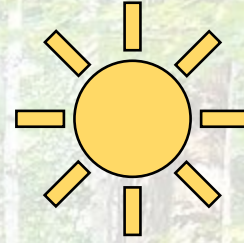
Pesticides...

- There are currently no products registered for use to manage jumping worms.
- Using pesticides for pests not listed on the label is likely to be ineffective
- Using consumer products or home remedies to control pests often poses many unintended consequences
- Research on effective products is ongoing.

**THE LABEL
IS THE LAW!**



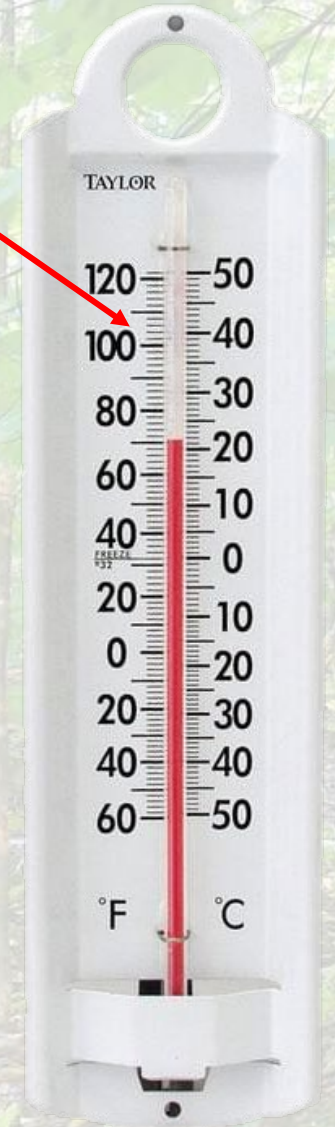
Management



3+ days

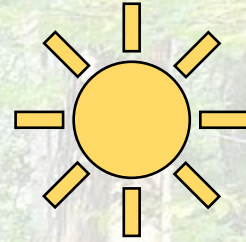
Consider solarizing infested soil in the summer

- Current research suggests:
 - Worms die $\sim 85^{\circ}\text{F}$
 - Worms and cocoons die $\sim 104^{\circ}\text{F}$ more than 3 days
- This only works in raised beds or containers that prevent the worms from fleeing the heat



Source: UMass Extension

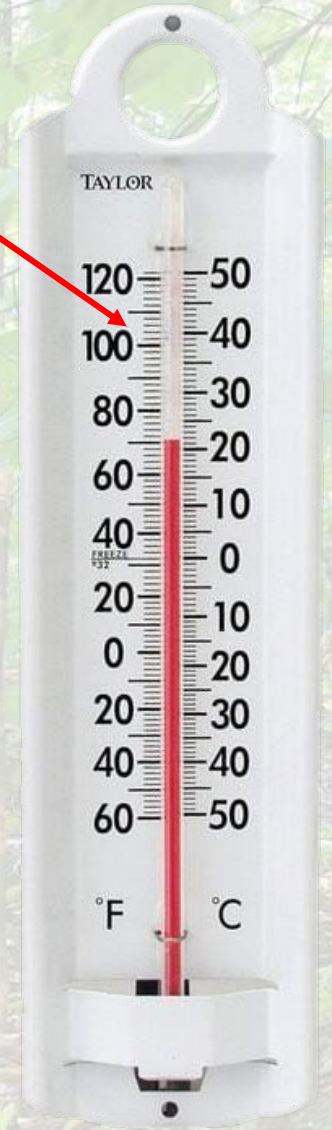
Management



3+ days

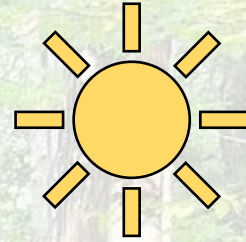
To solarize:

- Lay out thin layer (depth 6-8 inches) of infested soil, compost, or mulch onto a tarp
- Place clear plastic painter's drop cloth to make a solarization "package"
- Tuck the top sheet of plastic under the outer edge of pile, pull the bottom layer over the top sheet
- Secure with tape or rocks



Source: UMass Extension

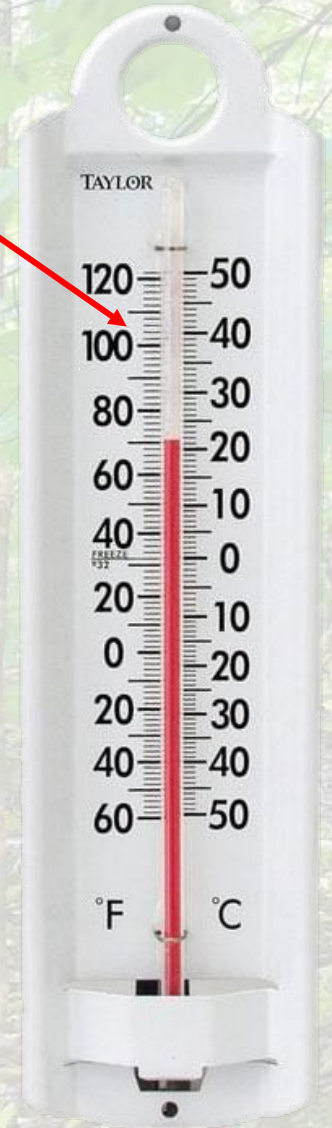
Management



3+ days

To solarize:

- Leave the package out in the sun for a minimum of three days
- This is only effective in the late spring/summer months



Source: UMass Extension

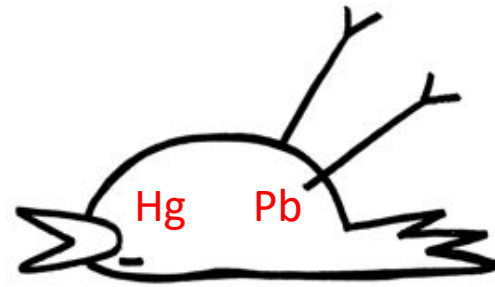
Management



Hand-removal of worms:

- Hand pick worms and put in soapy water
- Place worms in a bag, leave in the sun for a few days, then throw in the trash
- Removing worms will reduce cocoons
- *Is most effective with smaller infestations

Does anything eat them?



The early bird
ate too many worms
and died



FAQ's

Should I feed jumping worms to my chickens?

- No – jumping worms can be harmful to animals because they bioaccumulate metals (lead, mercury, arsenic, etc.) from soils



What is the state doing?

- Jumping worms are not a regulated invasive species in Maine – DACF cannot take action beyond education and outreach
- Multi-agency working group cooperating with University of Massachusetts, Cornell University, University of Vermont, and Yale University
- Surveillance study 2023

Lead Jumping worm researchers

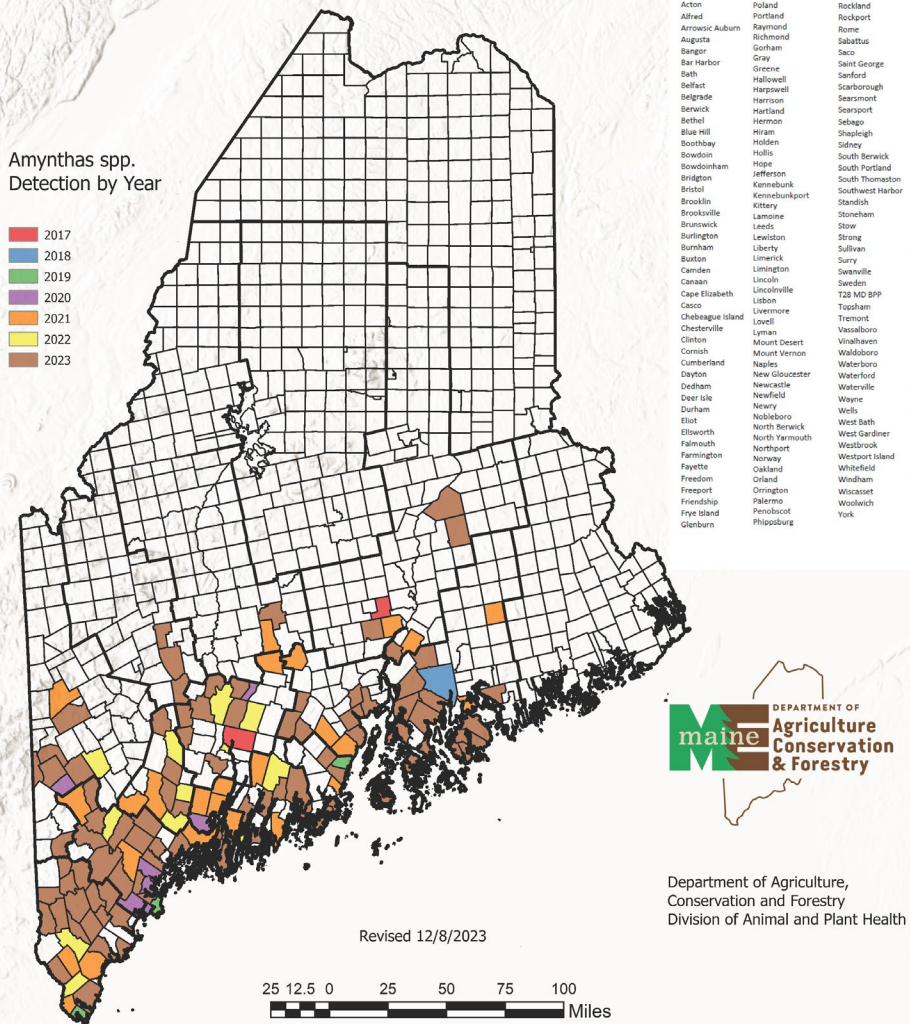
- Josef Görres – University of Vermont
- Annise Dobson – Yale University
- Brad Herrick – University of Wisconsin Arboretum
- Lee Frelich – Minnesota University Center for Forest Ecology
- Dr. Olga Kostromytska – UMass Stockbridge School of Agriculture

We are still learning!

- Jumping worms get a lot of attention; they are invasive, **but we are still learning** about their effects on gardens and forests and how to best manage them
- Don't panic. **Stay informed!**



Confirmed reports of *Amyntas* spp. in Maine by first reported year in town



Towns with *Amyntas* spp. Detections

Acton	Poland	Rockland
Alfred	Portland	Rockport
Arrowsic Auburn	Raymond	Rome
Augusta	Richmond	Sabatius
Bangor	Gorham	Saco
Bar Harbor	Gray	Saint George
Bath	Greene	Sanford
Belfast	Hallowell	Scarborough
Belgrade	Harpwell	Searsport
Berwick	Harrison	Searsport
Bethel	Hartland	Sebago
Blue Hill	Hermion	Shapleigh
Boothbay	Hiram	Sidney
Bowdoin	Hollis	South Berwick
Bowdoinham	Hope	South Portland
Bridgton	Jefferson	South Thomaston
Bristol	Kennebunk	Southwest Harbor
Brooklin	Kennebunkport	Standish
Brooksville	Kittery	Stoneham
Brunswick	Lamoine	Stow
Burlington	Leeds	Strong
Burnham	Leviston	Sullivan
Buxton	Liberty	Surry
Candlen	Limerick	Swanville
Canaan	Limington	Sweden
Cape Elizabeth	Lincoln	T28 MD BPP
Casco	Lincolnville	Litton
Chebeague Island	Lisbon	Topsham
Chesterville	Livermore	Trimont
Clinton	Lowell	Vassalboro
Cornish	Lyman	Vinhaven
Cumberland	Mount Desert	Waldoboro
Dayton	Mount Vernon	Waterboro
Dedham	Naples	Waterford
Deer Isle	New Gloucester	Waterville
Durham	Newcastle	Wayne
Eliot	Newfield	Wells
Ellsworth	Newry	West Bath
Falmouth	Nobleboro	West Gardiner
Farmington	North Berwick	Westbrook
Fayette	North Yarmouth	Westport Island
Freedom	Norport	Whitefield
Freeport	Norway	Windham
Friendship	Oakland	Wiscasset
Frye Island	Orland	Woolwich
Glenburn	Orono	York
	Palermo	
	Penobscot	
	Phillipsburg	



Department of Agriculture, Conservation and Forestry
Division of Animal and Plant Health

User: Jeff.Harriman O:\MFS\FHM\Harriman\Jumping Worm Confirmed Reports Esri, CGIAR, USGS

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MAINE DEPARTMENT OF Agriculture, Conservation & Forestry

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Horticulture Program

Jumping/Snake (Amyntas) Worms in Maine

On this page:

- [What are Amyntas Worms?](#)
- [History in Maine](#)
- [Why are Amyntas Worms a problem?](#)
- [Amyntas Worm Identification](#)
- [What can you do?](#)

What are Amyntas Worms?

Due to our history of glaciation, there are no native earthworms in Maine. Non-native earthworms from Europe (such as nightcrawlers) have become well established here through early colonial trading. Though they are beneficial to our gardens, earthworms can have destructive effects on our forests.

Amyntas worms are a type of earthworm native to East Asia. They are smaller than nightcrawlers, reproduce rapidly, are much more active, and have a more voracious appetite. This rapid life cycle and ability to reproduce asexually gives them a competitive edge over native organisms, and even over nightcrawlers. When disturbed, Amyntas worms jump and thrash about, behaving like a threatened snake.

European nightcrawler
Raised clitellum, further from head

Jumping worm
Smooth clitellum, closer to head

Amyntas Worm and Nightcrawler, Photo courtesy Wisconsin DNR

FEATURED LINKS

[Jumping Worm Report Form](#)

[Invasive Jumping Worm Frequently Asked Questions \(UMass Extension\)](#)

[Jumping/Crazy/Snake Worms Fact Sheet \(UMass Extension\)](#)

[Factsheet for Homeowners](#)

[Impacts and Implications of Non-native Earthworms in North America](#)

[State of the Science Jumping Worm Research & the JWORM Working Group \(Recorded Webinar\)](#)

[DACF iMap Invasives](#)

QUESTIONS?

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(207) 287-7545

[Jumping Worm Report Form](#)

OTHER CONTACTS



**Scan to
Report
Jumping Worms!**



**Thank you!
Questions?**

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207-287-7545

Resources

- Slides and research articles provided by:
 - Hillary Peterson – DACF IPM Specialist
 - Brittany Schappach – DACF MFS Forest Entomologist
 - University of Wisconsin
 - University of Vermont
 - Michigan Tech
- Specific journal article references available upon request to gary.fish@maine.gov